INTERAVIA

REVIEW OF WORLD AVIATION

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IN THIS ISSUE

Close-up of Farnborough and Madrid

The Powerplant Scene

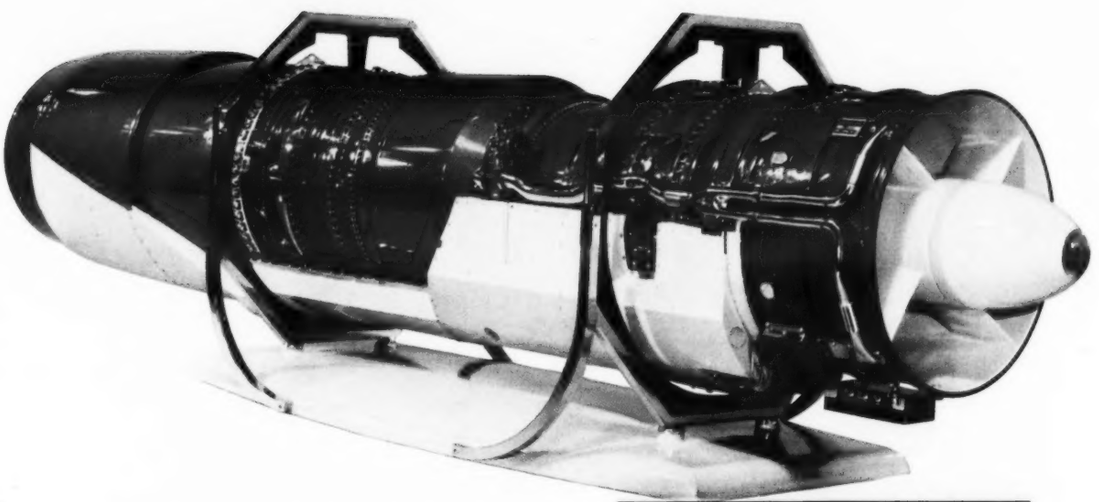
VOLUME XII **10** OCTOBER 1957

The world's newest supersonic jet engine...

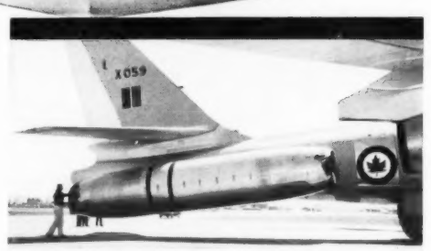
the

IROQUOIS

Selected to power production versions of the Avro Arrow for the R.C.A.F. the Iroquois is a jet engine of very advanced design, developing maximum thrust with minimum dimensions in a simple mechanical layout. Using modern materials including titanium, Orenda has developed an engine of very low weight.



The Iroquois designed, developed and produced by Canadians is the supersonic successor to the Orenda jet engine, 4,000 of which are in service on four continents.



FLIGHT TESTING THE NEW IROQUOIS AT MALTON
The supersonic Iroquois is carried in this specially designed pod at the rear of a B-47.

ORENDA ENGINES LIMITED

MALTON, CANADA

MEMBER: A.V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

INTERAVIA

Review of World Aviation

Volume XII **No. 10** **October 1957**

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FRONT COVER: Saunders-Roe SR.53 interceptor prototype with mixed propulsion (Armstrong-Siddeley *Viper* jet plus de Havilland *Spectre* rocket engine), a highlight of the S.B.A.C. Farnborough Display. — *Saunders-Roe photograph.*

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Distributors :

Austria Morawa & Co., Wollzeile 11, Vienna I
Canada Wm. Dawson Subscription Service Ltd., 587 Mount Pleasant Road, Toronto 12, Ont.
Edward Company Regd., P.O. Box 98, Station Delorimier, Montreal P.Q.
Finland Akateeminen Kirjakauppa, Keskuskatu 2, Helsinki
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Advertising Department : Publishing and Editorial Offices, Subscription Department : Interavia S.A., 6, Corraterie, Geneva. Telephone : 25 42 34 (five lines). Cables and Telegrams : Interavia-Geneva. Teleprinter : 22 122. Postal Cheque Account : Geneva I 5380.

Annual Subscriptions : U.S.A. and Canada, U.S. $7.00 ; United Kingdom and Eire, £2.2.0 ; Commonwealth, £2.6.0 ; Switzerland, 28.— fr. ; Austria, 170.— sch. ; Belgium, 320.— fr. ; Denmark, 48.— kr. ; France, 3000.— fr. ; Germany, 27.50 DM ; Holland, 25.— fl. ; Italy, 4060.— L. it. ; Japan, U.S.$7.00 ; Latin American countries, U.S. $7.00 ; Norway, 50.— kr. ; Spain, 280.— pts. ; Sweden, 35.— kr. All other countries, 28.— Sw. fr.

Appears Monthly in Four Editions : English, French, Spanish and German.

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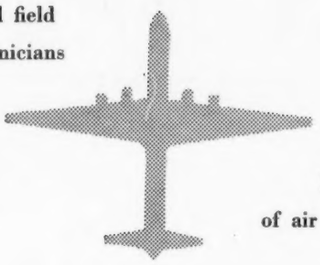
Each special field
has its technicians



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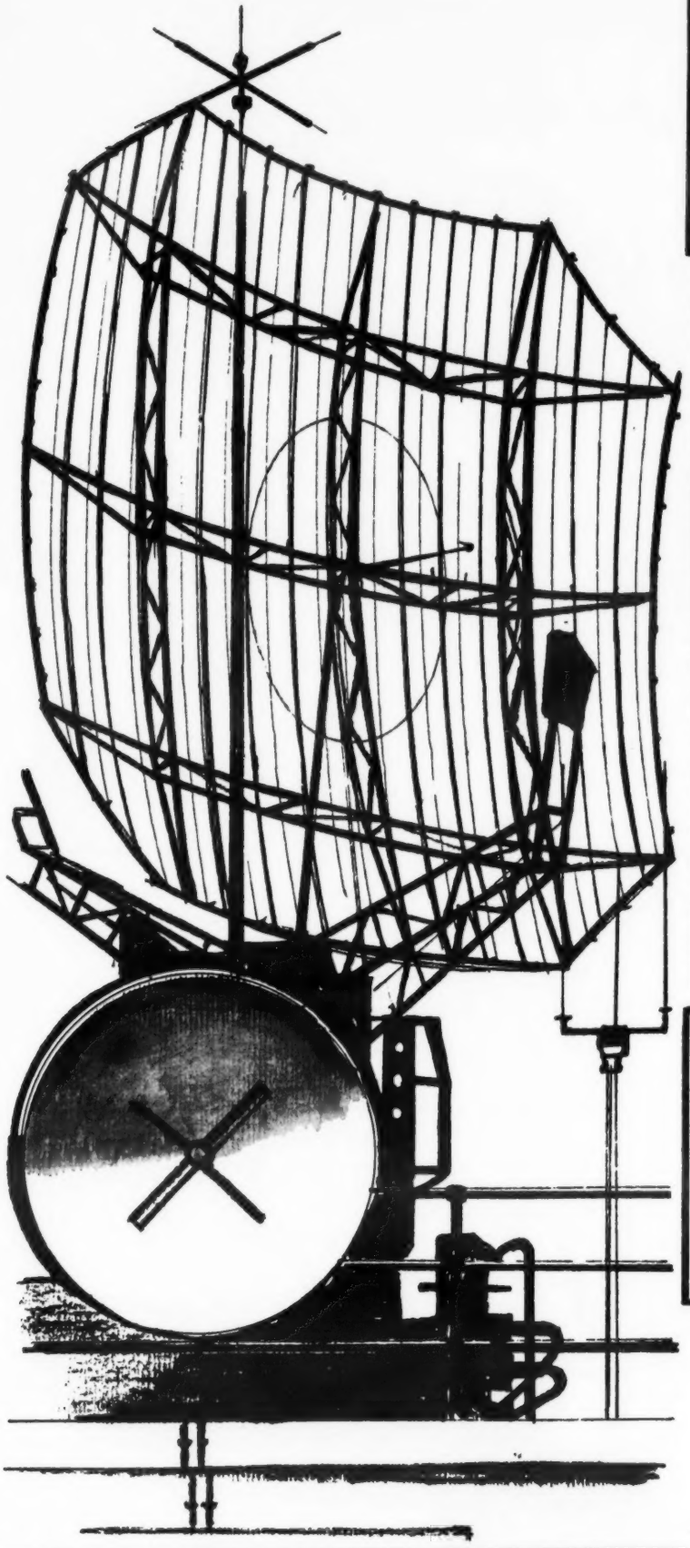
FIAT AVIATION

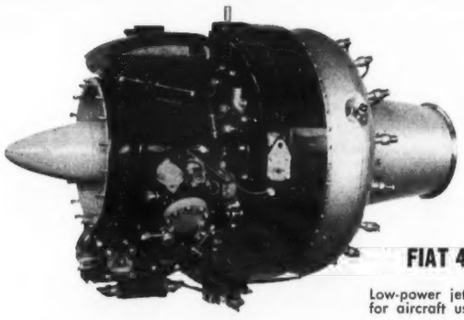


Light tactical support fighter (N.A.T.O.).
Main advantages of this aircraft: limited dimensions, light weight, low unit cost and operating costs, ability to operate from semi-prepared fields and grass runways.

FIAT G 91

FIAT G 91 T

Two-seat version for advanced training in the transonic range. Retains all the basic advantages of the single-seat model (Mach 1+).



FIAT 4002.001

Low-power jet engine for aircraft use.

FIAT - DIVISIONE AVIAZIONE
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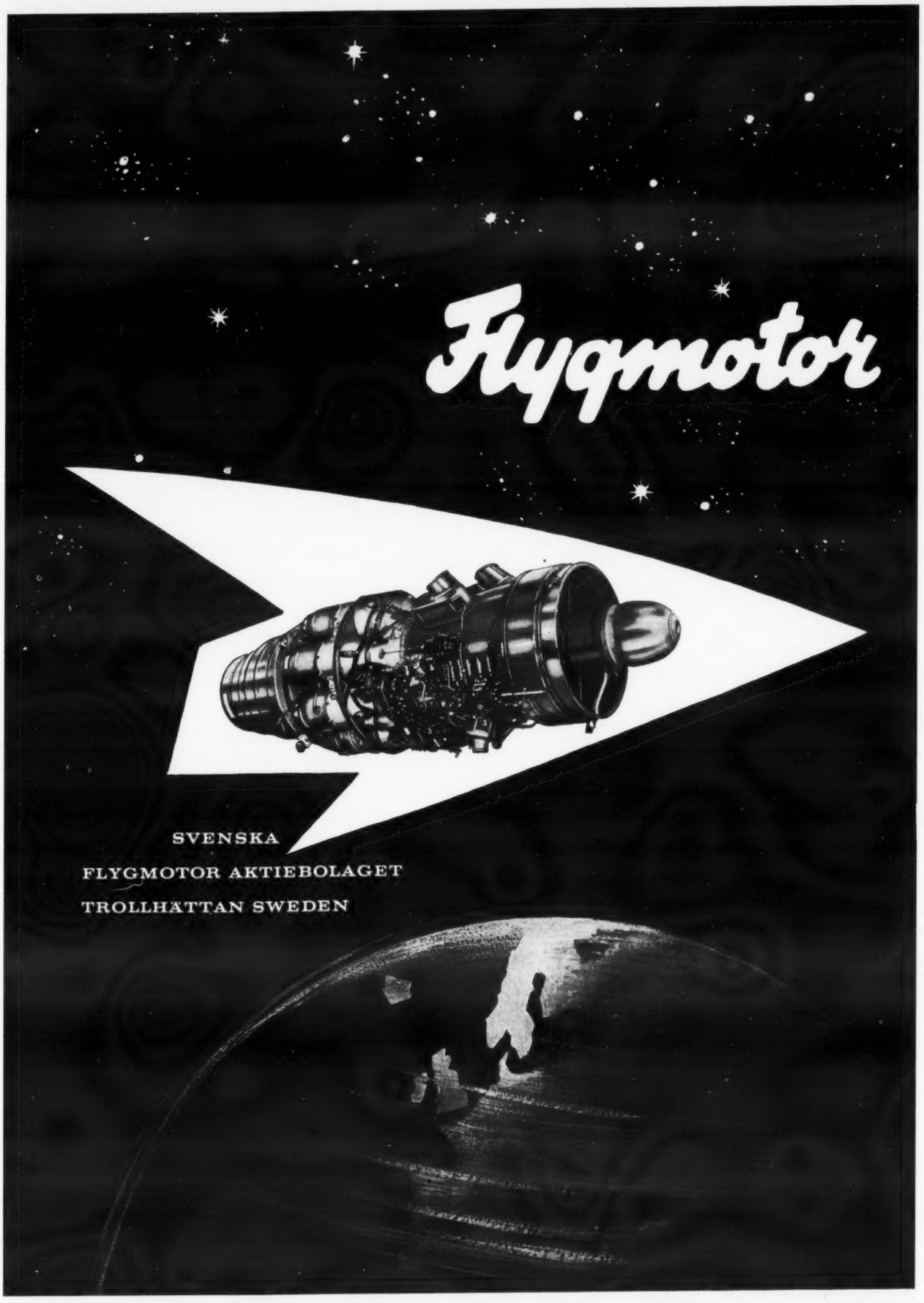
Sicherheit
IN DER LUFT
DURCH
TELEFUNKEN- Radar
TELEFUNKEN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Paris-New York non-stop...

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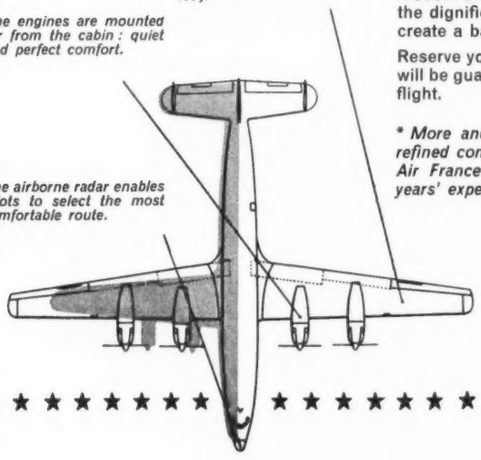
The engines are mounted far from the cabin : quiet and perfect comfort.

The airborne radar enables pilots to select the most comfortable route.



Between Europe, the United States and Mexico, Air France is using the most modern of trans-Atlantic aircraft, the Super Starliner, a new four-engine giant which connects Paris with New York non-stop at 350 m.p.h. !

The Super Starliner's luxurious interiors have been designed by Air France for your pleasure and your comfort. They are definitely modern and reflect the best French taste : the gay and restful colours, the dignified materials and the care given to each detail combine to create a background of elegance and comfort . . .

Reserve your seat now aboard an Air France Super Starliner and you will be guaranteed a pleasant, fast and restful journey . . . an excellent flight.

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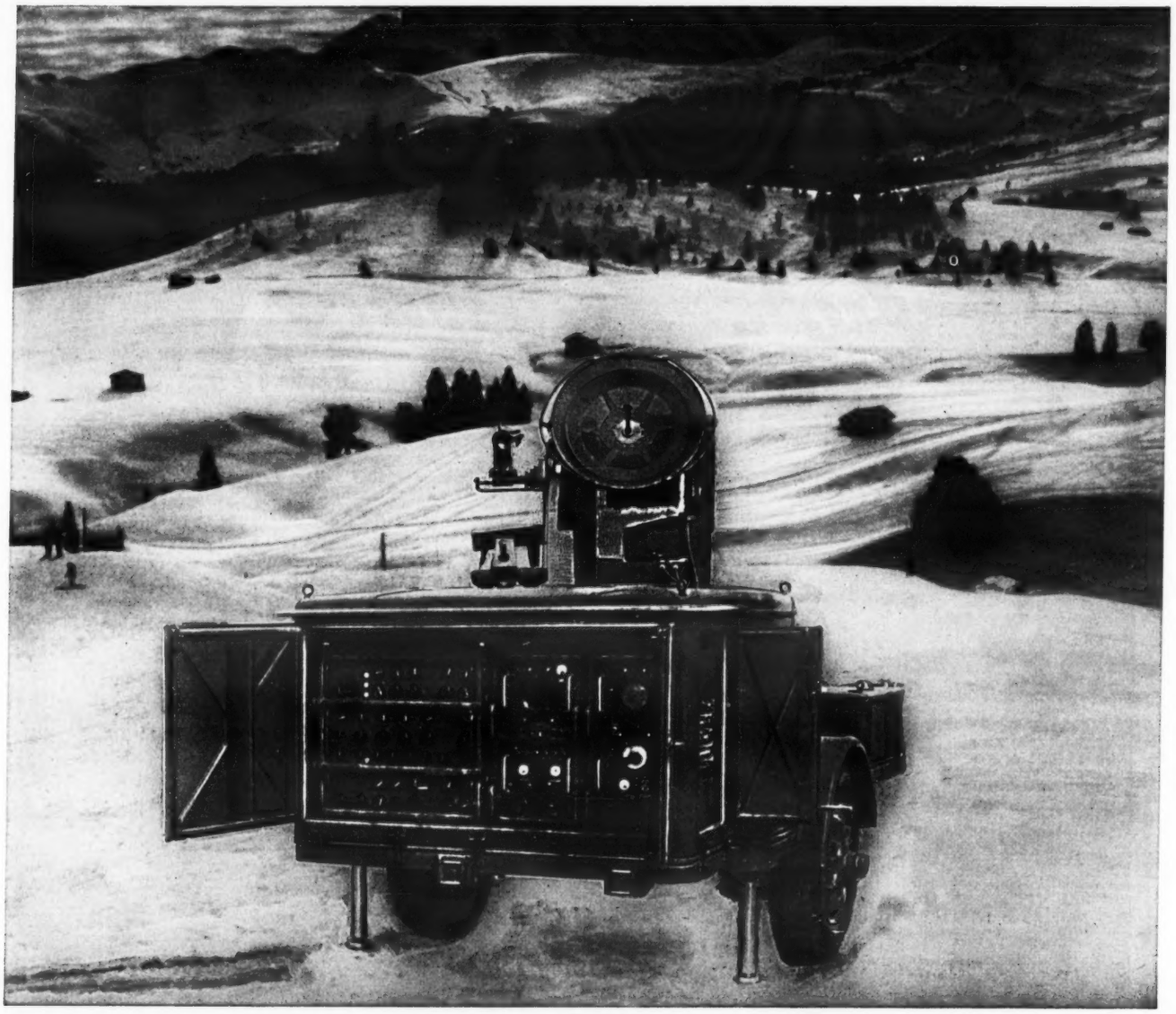
CONTRAVES has been supplying gun directors for 11 years; they are used in 11 Countries both by Army and Navy.

The Contraves directors were so designed, built and tested to operate under the most critical atmospheric conditions. Here is, for instance,

THE BAT, FIRE CONTROL SYSTEM FOR 40 mm. GUNS

while operating at very low temperature.



BEFAB Safeland arresting nets in action

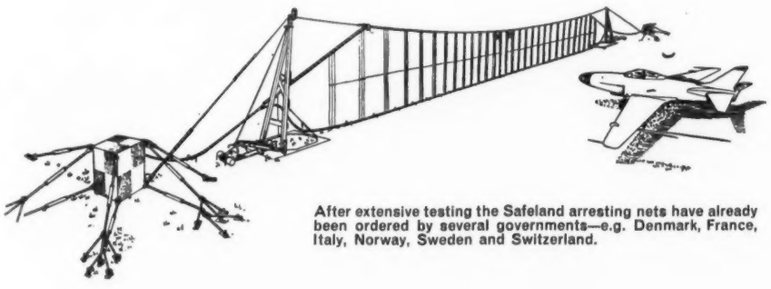
A Republic F 84 G Thunderjet dashing into the BEFAB Safeland arresting net at a speed of 100 miles per hour.

At Rygge Military Airport in Norway Lieutenant Holter-Sörensen went through some exciting seconds when his Thunderjet dashed towards a BEFAB Safeland arresting net at the speed of 100 mph. The aircraft's weight was 16 000 lbs and the braking distance about 280 feet. No damage was caused either to the aircraft or to the arresting gear.
The Safeland arresting nets, which are Swedish patented and designed by the Royal Swedish Air Board, are put up at the ends of the airport runways. The standard length of a net is 180 feet and in this case the height was about 8 feet.

The BEFAB Safeland arresting nets are presently manufactured for all types of aircraft up to 65 000 lbs gross weight at engaging speeds up to 165 mph.

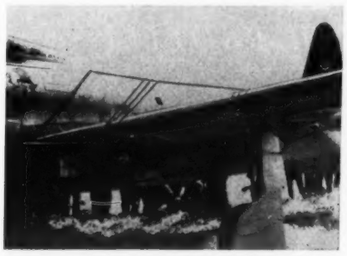
Modern Swedish emergency arresting equipment incorporating the following capabilities :

1. Stabilizes aircraft entering webbing asymmetrically, e.g. when skidding or ground-looping.
2. Causes little or no damage to the aircraft.
3. Simple rigging.
4. Easy to handle and to move from place to place.
5. No extra force on nosewheel.
6. Very low installation costs.
7. Total weight of the equipment about 5000 lbs.



After extensive testing the Safeland arresting nets have already been ordered by several governments—e.g. Denmark, France, Italy, Norway, Sweden and Switzerland.

Pilot leaving the plane after the successful arresting.



This picture shows how well and carefully the net has engaged the plane.

Exclusively manufactured by

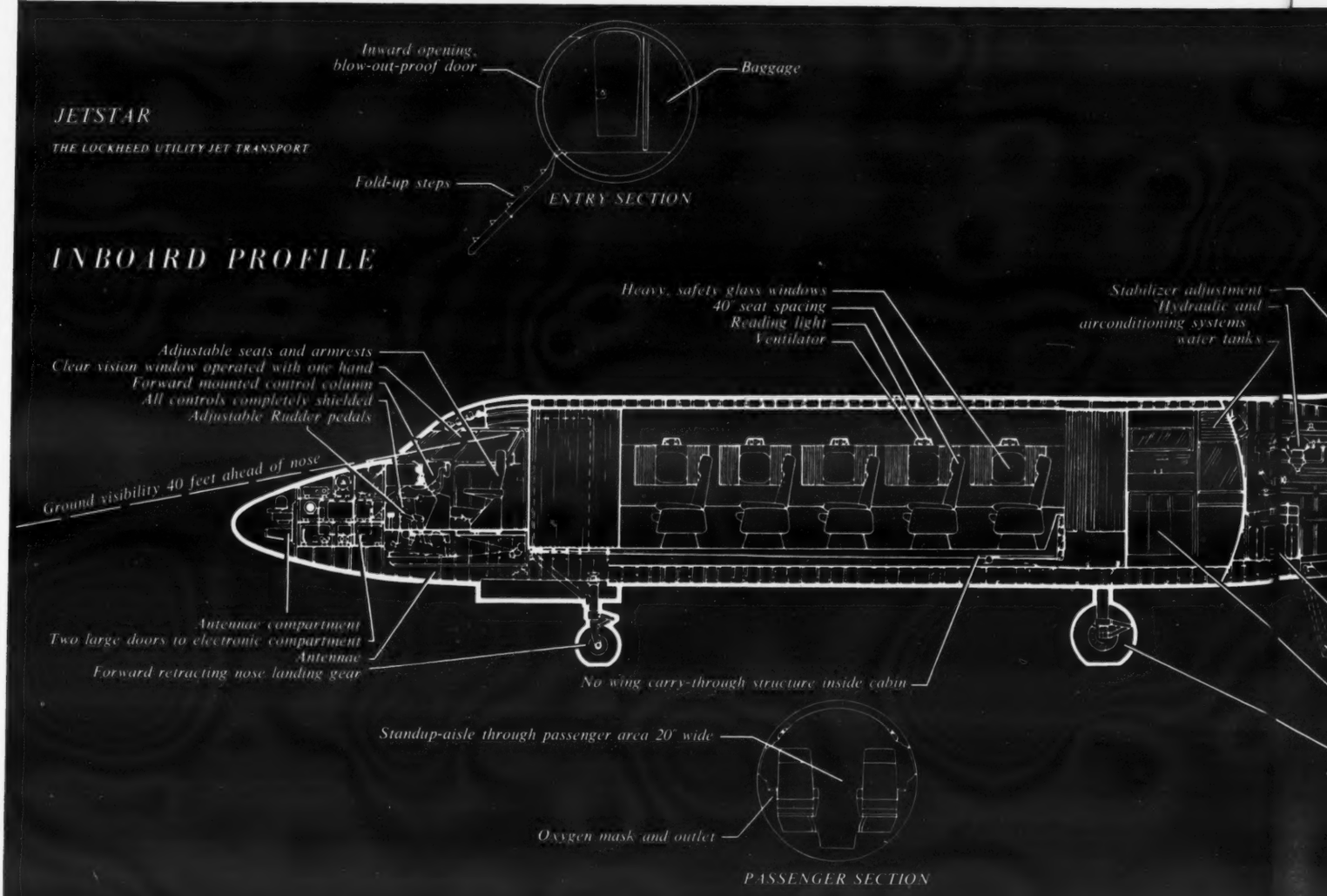
BEFAB BORGS FABRIKS AB
NORRKÖPING - SWEDEN

Designer: Royal Swedish Air Board

JETSTAR

THE LOCKHEED UTILITY JET TRANSPORT

INBOARD PROFILE



ANNOUNCING THE NEW LOCKHEED JETSTAR

a 10-passenger utility jet transport with 4 engines, designed to perform a variety of Jet Age military missions at low cost.

Anti-collision light
Baggage
Easy access to aft equipment and baggage compartment
Large dive flap for rapid let-down
Full size, completely appointed lavatory
Landing gear hydraulically or gravity extended

Able to match the performance of large jet transports, but at a fraction of their costs, the new swept-wing Lockheed JETSTAR will cruise 500/550 mph at altitudes from 25,000 to 45,000 feet—for ranges of 2,000 statute miles and more.

Amazingly quiet (due to the aft fuselage mounting of engine jet pods) the JETSTAR is ideal for transition pilot training, heavy bomber crew training, and testing ground navigational aids. High-speed navigation training and gunnery practice, in-flight refueling indoctrination, and high-priority cargo carrying are additional vital uses for which the JETSTAR was designed.

The JETSTAR carries a full complement of radio and navigation gear and is fully pressurized and air conditioned.

Like all Lockheed aircraft, the JETSTAR embodies simplicity of structure and functional systems—for high strength and reliability. Easy to maintain, economical to operate, the JETSTAR carries on the 25-year tradition of Lockheed's leadership in the design and manufacture of high-speed aircraft for the military, commerce and industry.

LOCKHEED *means leadership*

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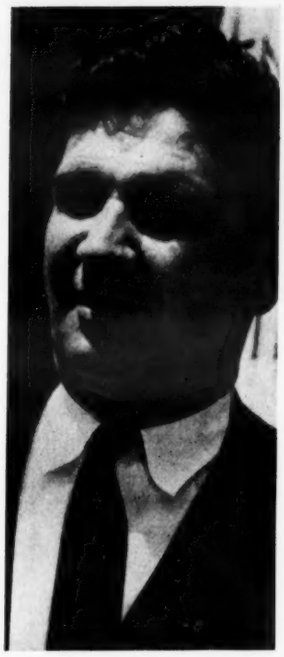
Georgia Division
Marietta, Georgia, U.S.A.
Makers of the prop-jet C-130 HERCULES

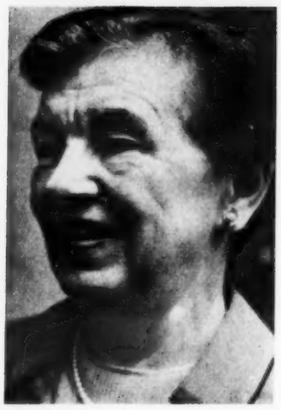
23
1950: 2000 m
23
1957: 2600 m
23
1960: 3900 m
GENEVA
is preparing
for the jet aircraft age
GENEVA AIRPORT

William Flynn, The Boston Globe : " Flying in the Boeing 707 is more than a means of travelling from here to there in an unbelievably short time though the distance is thousands of miles. Seven-Oh-Seven flight is winged luxury, comfort—with a complete sense of security—in a peaceful void of blue high above the earth."

Walton and Richard Tregaskis, author team : " Flying in the 707 isn't like flying through air any more. It's as if you were moving through something more nearly solid, like water—as in a submarine, the water holding you firmly and smoothly. It's as if you were held steadily on a track, not just in air. You feel secure and steady, despite the fighter-like performance."

Albert D. Hughes, The Christian Science Monitor : " If the reaction of this and other reporters aboard the flight may be taken as a guide, jet travel will be popular with the public. High-speed flight, moreover, is a pleasant sensation marked with smoothness, cabin quiet and lack of vibration, notably different from contemporary aircraft."





Lucia Lewis, Chicago Daily News : " Taking off in a Boeing 707 is a dream-like thing. No roar of engines, vibration, air pressure changes. The swift climb to 35,000 feet is effortless. You shoot along like an arrow, yet chat in complete quiet. This is utterly restful travel—a feature as sensational as the tremendous speed of the Boeing 707."

The reports above are a preview of what *you'll* experience when you fly in the superb Boeing 707 jetliner. They are by five of the writers who earlier this year flew across the U.S. in the 707 at an average speed of 612 miles an hour.

These airlines already have ordered 707s : AIR FRANCE · AIR INDIA · AMERICAN · B.O.A.C. · BRANIFF CONTINENTAL · CUBANA · LUFTHANSA · PAN AMERICAN · QANTAS · SABENA · TWA · VARIG

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The AERO SUPER is a cantilever twin-engined low-wing monoplane with an enclosed cabin accommodating the pilot and three passengers. It is powered by two Walter Minor 4-III engines of 105 b.h.p. each, with type V 401 electrically controllable pitch propellers. Its range is 1500 km, its fuel consumption rate being 50 litres per hour.

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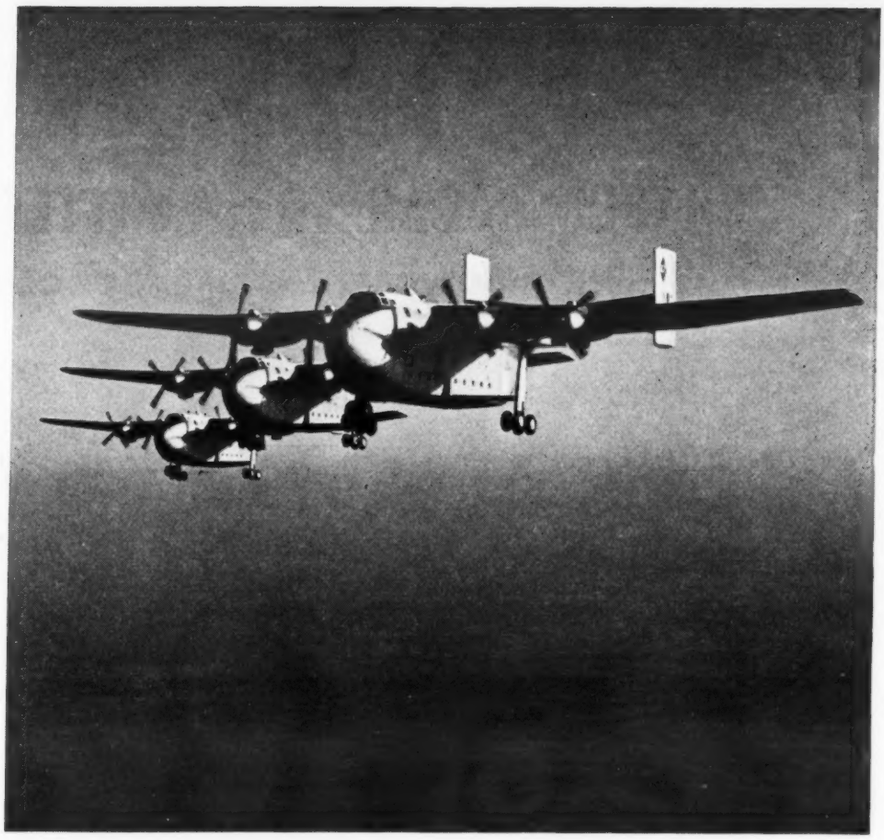

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SR1000 RADAR TRANSMITTER RECEIVER

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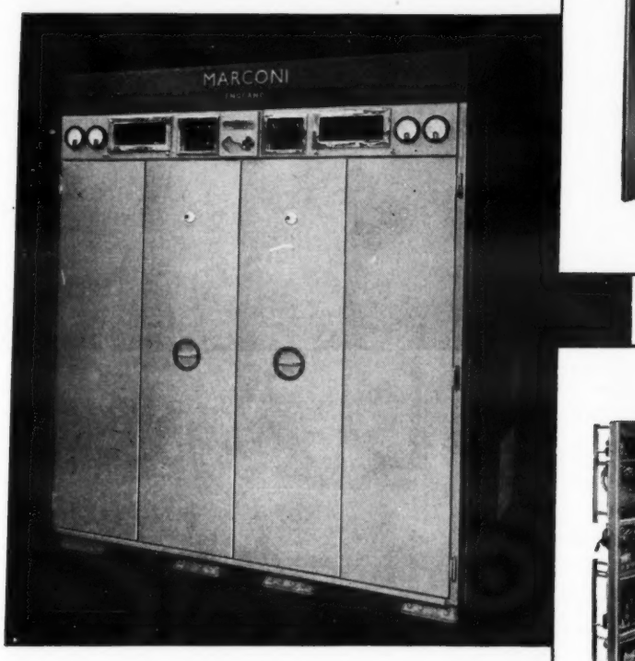
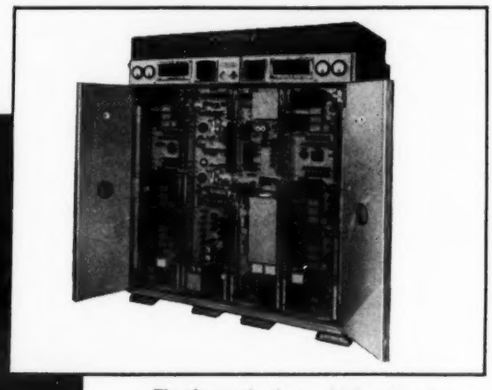
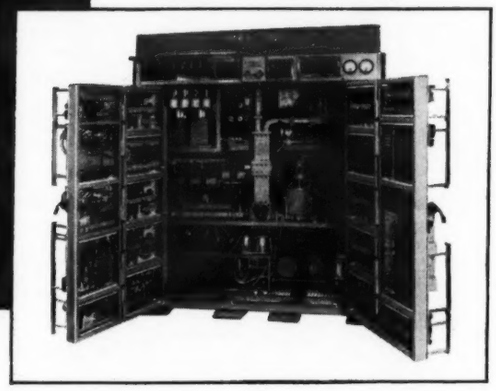




The photographs above and below show the ingenious door mounting arrangement of the units which gives complete accessibility



The SR 1000 transmitter has a peak power of three megawatts at 10cm. The receivers are linear and logarithmic. The equipment includes fully comprehensive monitoring facilities and self-contained test equipment. All this and duplexer, magnetron, trigger, impulse transformer and HT supplies are contained within a cabinet measuring only 6 ft. 3 ins. by 3 ft. 4 ins. by 7 ft. 3 ins., to which revolutionary mechanical design gives complete freedom of access.

MARCONI

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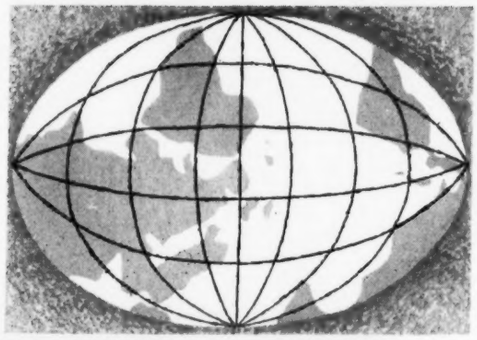
THE BELL HELICOPTER



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INDONESIA, Djakarta
Indonesian Planning Office, Ltd.

IRAN, Tehran
Salar Bahktair

IRAQ, Baghdad
Atlas Company, Ltd.

ISRAEL, Tel Aviv
Cidev Company, Ltd.

ITALY, Gallarate
Costruzioni Aeronautiche

JAPAN, Tokyo
Daiichi Bussan Kaisha

KINGDOM OF JORDAN, Jerusalem
Egor J. Farradj

LEBANON, Beirut
Abdunnur Commercial & Engineering Co.

MEXICO, Mexico, D.F.
Guillermo Prieto A.

THE NETHERLANDS, Rotterdam
Messrs. Thalassa, N.V.

NEW ZEALAND, Auckland
Seabrook Fowlds, Ltd.

NICARAGUA, Managua
Roger Bermudez B.

NORTH RHODESIA, (Africa) Kalulushi
Autair Helicopters, Ltd.

NORWAY, Oslo
Scancopter A/S

PAKISTAN, Karachi
Ali Automobiles, Ltd.

PANAMA, Panama City
C. H. Deerwester

PARAGUAY, Asuncion
Nicolas Bo, S.A.

PERU, Lima
Inter-Continental Trade Co., S.A.

PHILIPPINES, Manila, Luzon
Campos, Rueda & Sons

PORTUGAL, Lisbon
Daun & Bleck, Ltda.

PUERTO RICO, San Juan
Caribe Helicopter Sales

SAUDI ARABIA, Al Khobar
General Contracting Company, Ltd.

SPAIN, Madrid
Iberavia, S.A.

SURINAM, Paramaribo
Surinam Airways Company, i.o.

SWEDEN, Stockholm
Ostermans Aero AB

SWITZERLAND, Zurich
Forrer-Fenwick, S.A.

SYRIA, Damascus
Khalil Fattal & Fils

THAILAND, Bangkok
Suphan Phanich Company, Ltd.

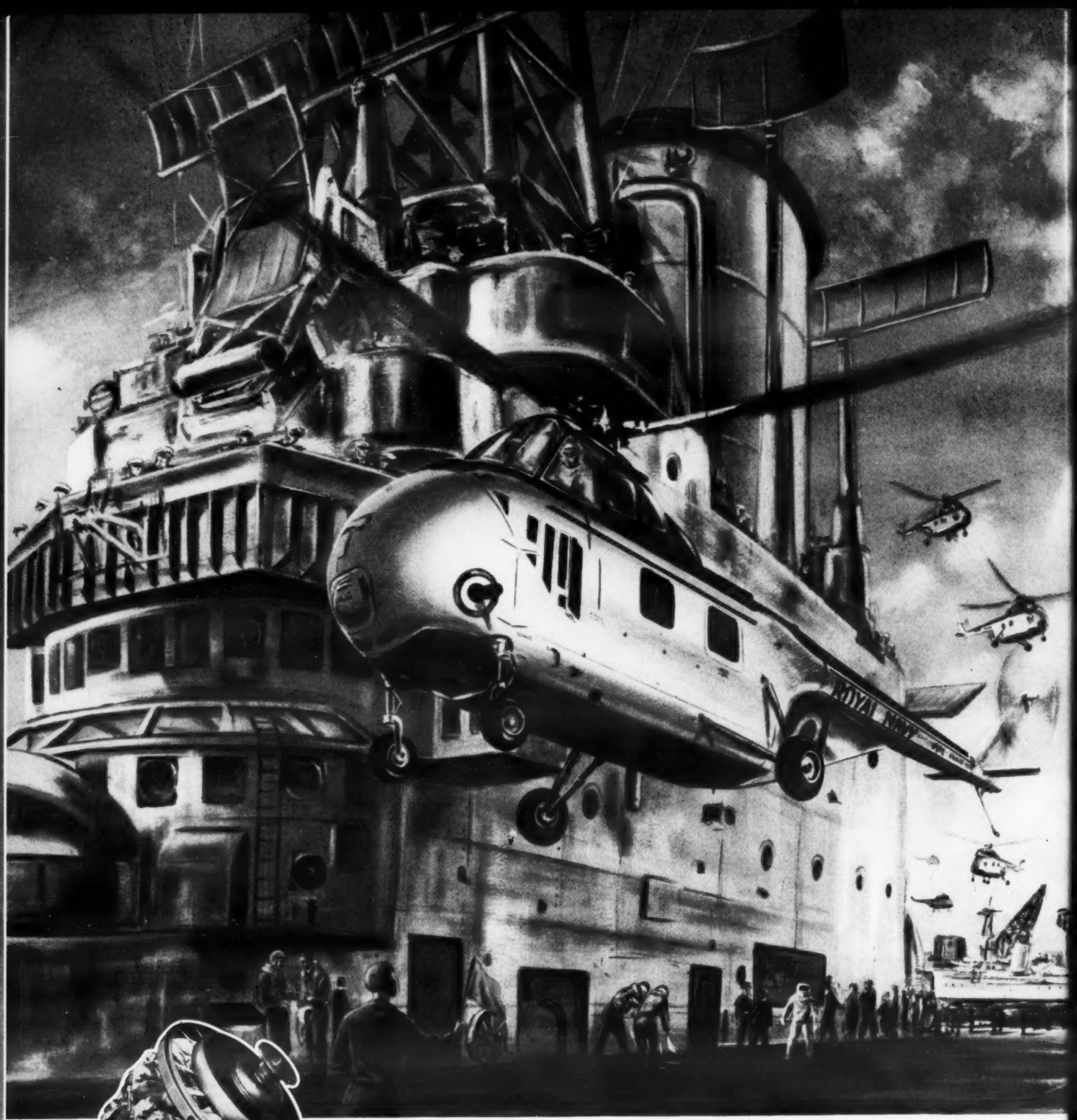
TURKEY, Ankara
Polar Mining and Industrial Corp.

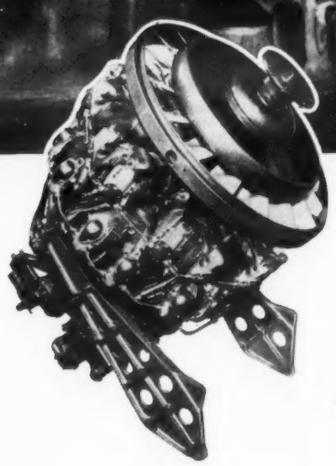
URUGUAY, Montevideo
Pike & Cia, Ltd.

VENEZUELA, Caracas
Venairco, S.A.

VIRGIN ISLANDS, St. Thomas
Caribbean Corporation

YEMEN
Michael Baker, Jr., Inc.





In service with the Royal Navy

The Alvis Leonides Major has been chosen to power the Westland Whirlwind helicopters now being delivered to the Royal Navy.

ALVIS

ALVIS LEONIDES Aero Engines

ALVIS LIMITED · COVENTRY ENGLAND

INTERAVIA

Deadline Notes

No. 10, 1957

● **European collaboration** in the production of certain French aircraft types is being organized. In order that quantity production of the Breguet 1001 Taon should be simplified, Société Breguet has been promised the collaboration of a number of European aircraft manufacturers ; an understanding has been reached with West German Dornier Works for the complete licence production of the Breguet 1001 in the Federal Republic, and preliminary talks are under way on the participation of Italian and British factories in the Taon production programme ; in the Benelux countries an agreement already exists with Fokker. G. A. Marcel Dassault has announced agreements which will make possible the joint production of the Etendard VI ground support aircraft by several European countries ; Orpheus engines are to be supplied by Bristols of England, and quantity production of the aircraft is to be launched jointly with Fiat of Italy and the West German aircraft industry. Sud-Aviation and Fiat have signed an agreement on the production of sub-assemblies for the SE.201 Caravelle twin-jet transport in the Turin works of Fiat. Société Air Fouga has concluded a licensing agreement with Bedek Aircraft Ltd. of Israel with the collaboration of OFEMA ; the Israeli company will manufacture the Fouga CM 170 Magister jet trainer in quantity, and Israeli experts are visiting the Fouga works to discuss inauguration of production at Lydda.

● **Captive firings of the Thor I.R.B.M.** are scheduled to begin soon at a new testing base near Sacramento, Calif. It is understood that the Thor will not be launched from Sacramento. The testing site has been constructed under a joint U.S.A.F. and Douglas Aircraft Co. contract, with both sharing in the investment of more than $ 6,000,000. More than 100 scientists and technicians are already in Sacramento to make plans for the test firing.

● **The first regular air-to-ground telephone service** in the United States has been inaugurated by the Illinois Bell and Michigan Bell Telephone companies. To begin the one-year experimental service, one government aircraft and eleven private aircraft have been equipped with radio-telephones. Passengers aboard these aircraft, flying near Chicago or Detroit, will be able to make telephone calls to any part of the United States.

● **An order for an additional 21 Avon-Sabre fighters** is expected to be placed by the Australian Government with the Commonwealth Aircraft Corporation, bringing the total order to 111 aircraft. This is a stopgap order, with a minimum rate of production, to maintain the CAC production pending decisions on a new fighter project for the RAAF—now expected to be the twin-jet, lightweight supersonic Northrop general purpose fighter which is in development.

● **A.I.C.M.A. :** The annual meeting of the Association Internationale des Constructeurs de Matériel Aéronautique will be held on October 10th and 11th in Munich.

● **Trans World Airlines and Northwest Airlines** will link their routes on January 1st, 1958, to provide a second round-the-world air service by U.S. flag airlines, the two companies announced in a joint communiqué. The new air service will link cities in North America, Europe and Asia. The decision to join routes was made possible by a recent Civil Aeronautics Board ruling under which T.W.A. was authorized to extend its present services from India and Ceylon through Bangkok to Manila, where it will connect with Northwest's trans-Pacific flights.

● **ALAI**, the new unified Italian airline, Alitalia, Linee Aeree Italiane, will take over at midnight on October 31st all the services previously operated by Linee Aeree Italiane. The original plan for the services to be taken over progressively has had to be dropped because of administrative difficulties.

● **Republic Aviation Corp.** is building a $ 1,200,000 wind tunnel facility at Farmingdale, N. Y. for missiles, rockets and aircraft. The facility will consist of two wind tunnels, one of which will deal with aerodynamic problems in the transonic areas, the other will be used in tests up to Mach 4.

● **Pacific Southwest Airlines** has announced the purchase of three Lockheed Electras at a total cost of $ 8,000,000 including spares. Pacific Southwest, a California company, is the first local service airline to order Electras.

● **Cathay Pacific Airways Limited** has placed an order with Lockheed Aircraft Corporation for two Electra airliners to be delivered in June and August 1959. The company will operate the Electras out of Hong Kong to destinations in South East Asia.

Flying Equipment at the Brno Engineering Exhibition

The Third Czechoslovak Machinery and Engineering Exhibition organized by the Czechoslovak Chamber of Commerce in Brno from September 1st to 22nd, attracted such a large number of visitors, particularly from outside Czechoslovakia, that the organizers decided to extend it for another week, to September 29th.

Of particular interest is the fact that the Czech aircraft industry took part in the exhibition on a major scale for the first time.

Omnipol S. A. (State trading organization for the export of aircraft, aero engines and accessories) showed a good half dozen sports, touring and agricultural aircraft in a static show, while the Aviation Pavilion contained not only the well-known Super Aero twin-engine executive transport, but also aircraft engines (including a jet with radial compressor and single-stage turbine), propellers, aircraft instruments and test equipment for aviation use.

Omnipol S.A. also had all Czech civil aircraft types lined up on Brno Airport for demonstration flights. *Interavia*'s reporter who visited Prague and Brno had an opportunity of flying three of the latest types : the L.40 Meta Sokol three-to-four-seat sports aircraft, the L.60 Brigadyr four-seat STOL aircraft for

passengers and freight (also supplied as an agricultural, ambulance or survey aircraft) and the HC.2 Heli-Baby two-seat light helicopter (so far available only in prototype form).

The Avia 14 twin-engine short and medium stage commercial transport (two M.82-T engines of 1900 CV each, with direct fuel injection, now built under Russian licence in Czechoslovakia) for 32 passengers, and the L.200 twin-engine, 4-5-seat executive transport, which can also be used for training, courier services and as an air taxi, were shown to the public for the first time at Brno.

The following data have been released for the L.200, of which two prototypes have so far been built : max. speed 162 knots (300 km/h), cruising speed 148 knots (275 km/h), max. range approximately 860 nautical miles (1,600 km). The first prototype of this all-metal low-wing monoplane, with hydraulically retractable nose-wheel undercarriage and wing-tip tanks, has so far completed roughly 250 hours of test flying.

The twin-engine Avia 14 shown at Brno Airport is the first aircraft of this type equipped for 32 passengers (with fuselage lengthened by about 3ft 3ins = 1 m). Passengers' seats are arranged two abreast on either side of the central gangway ; the cockpit is equipped for pilot, co-pilot and radio operator/navigator. The model demonstrated at Brno still carries a large number of instruments of Russian design, but later models are to have Czech equipment and instruments throughout. The Avia 14 is not pressurized. It can, however, operate from grass runways (Brno Airport has no concrete runway) and has a take-off run of 490 yards (450 m) and a landing run of 600 yards (550 m).

Also demonstrated on the ground and in the air was the Z.226 Trener two-seat sports aircraft and trainer, with Walter Minor 6-III engine, now in large-scale production and available in two different versions. The Z.226 B is a towing aircraft with single controls and emergency seat for a glider pilot, while the Z.226 T is a trainer and aerobatic version with dual controls.

The most interesting of the low-power engines exhibited was probably the M.332 air-cooled 4-cylinder in-line engine (take-off rating 140 hp at 2,700 r.p.m., sea level) with inverted cylinders and low-pressure fuel injection system, shown at this year's Paris Salon. The engine is equipped with a supercharger for short period operation, with electric starter.

Finally, a variety of equipment items, in particular aircraft instruments, was also on show in the Omnipol pavilion. These included the LUN 1201 electrical artificial horizon for aircraft of all categories, with unrestricted freedom of rotation about both axes (weight 2.65 lb = 1.2 kg) ; LUN 1202, 1207 artificial horizons (the latter is basically similar to the LUN 1202, but is fed direct from the D.C. battery without use of a current converter) ; LUN 1101 air speed indicator (for speeds up to 215 knots = 400 km/h) ; LUN 1103 (up to 430 knots = 800 km/h) ; also variometers, altimeters, etc. Of particular interest was a small test laboratory for the testing and calibration of instruments, etc. (including oxygen equipment, fire warners, air speed indicators, Mach meters, altimeters, blower pressure gauges). Finally, Czech-made parachutes were to be seen, including the Model PTCH with a carrying capacity of 265 lb (120 kg) and suitable for use at flying speeds up to 160 knots (300 km/h) ; rate of descent 16.4 ft/sec (5 m/sec). A pictorial report of some of the most recent productions of the Czechoslovak aviation industry and data on civilian aircraft and power units will be published in *Interavia Review* No. 12, December 1957.

From the INTERKAMA Catalogue*

An International Congress on Metering and Automation Techniques and an Exhibition of Equipment at Düsseldorf, Germany, from November 2nd to 10th, 1957.

• **Askania-Werke A.G. (Berlin-Friedenau) :** Electric, hydraulic or pneumatic controls ; metering equipment and monitoring systems.

• **Atlas-Werke A.G. (Bremen) :** Equipment from the production programme of the Metering and Analysis Division, including several special types of mass spectrometers.

• **Kurt Brandau, Messautomatik** (Düsseldorf) : Equipment for the evaluation of mechanical values.

• **DEGUSSA** (Hanau/Main) : Electric temperature sensing elements (resistance thermometers and thermoelements) for applications in the range —253° C to + 1,800° C.

• **Deutsche Waggon u. Maschinenfabriken GmbH.** (Berlin-Borsigwalde) : Climatic chamber for laboratory testing of materials and equipment under constant or variable temperature and humidity conditions.

• **DISA Electronik** (Copenhagen) is exhibiting for the first time in Germany and is represented by Alfred Neye of Frankfurt. A most interesting equipment from the field of industrial electronics is the *Universal Indicator 51 B 00*, a precision double beam oscillograph for the measurement and photographic recording of mechanical and electrical values.

• **Electronic Associates Inc.** (Long Branch, New Jersey) : PACE - Precision Analog Computing Equipment. This equipment has recently been made available at the company's Analog Computation Center established in Brussels.

• **Frieseke & Hoepfner GmbH.** (Erlangen-Bruck) : Radiation measuring, detection, recording and amplifying equipment ; lead shielding. Of special interest are the FH 46 Measurement and Control Units which permit continuous measurement and registration of the weight per unit area or thickness of sheet and foil materials during manufacture, without physical contact with the materials.

• **Fritz Hellige & Co. GmbH.** (Freiburg i.B.) : High speed graphic recorders for the accurate registration of rapidly occurring movement up to 120 c.p.s.

• **Honeywell GmbH., subsidiary of the Minneapolis - Honeywell Regulator Co. (Frankfurt/Main) :** Electronic and pneumatic control circuits for temperature, pressure and flow.

• **IBM - Internationale Büromaschinen-Gesellschaft** (Sindelfingen) : Automatic Production Recording System, a new, self-contained rationalisation device to provide coordination between production and administration.

• **Kipp & Zonen** (Cologne) : *Mikrograph* recording microvoltmeter, a highly sensitive and high speed graphic recorder with high zero constancy and linearity.

• **Laboratorium Prof. Dr. Berthold** (Wildbad/Schwarzwald) : Non-destructive material testing equipment ; scintillometers.

• **Rohde & Schwarz** (Munich 9) : Voltmeters ; amplifiers ; oscillographs ; frequency reference equipment ; quartz clocks ; LF, HF, RC and TV generators ; AM and FM test transmitters and receivers ; UHF test transmitters ; power test equipment ; clystron supply units ; centimetric wave guides etc.

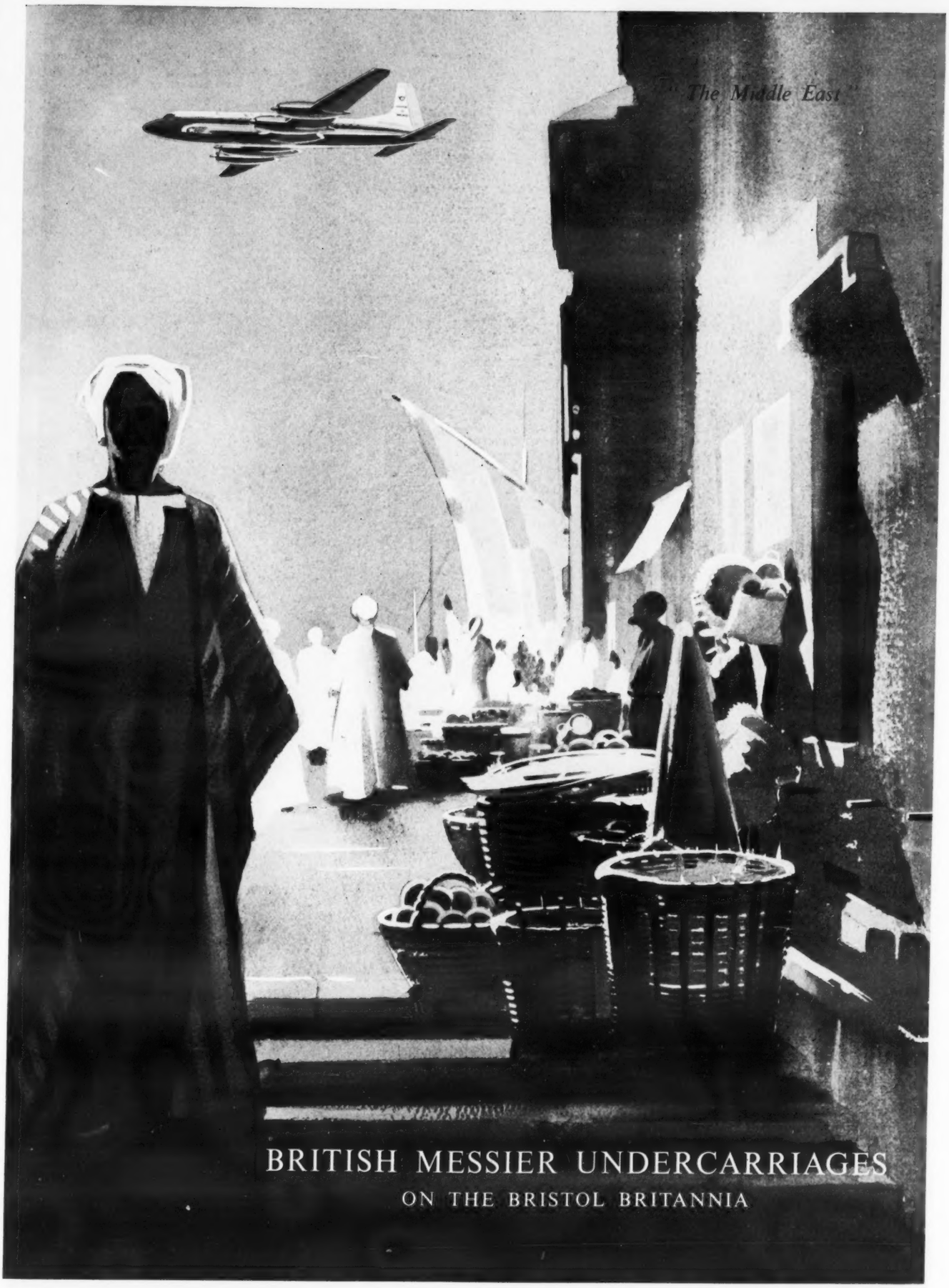
• **Siemens-Schuckertwerke A.G.** (Berlin and Erlangen) : A series of examples of various applications of command and control systems for power current installations.

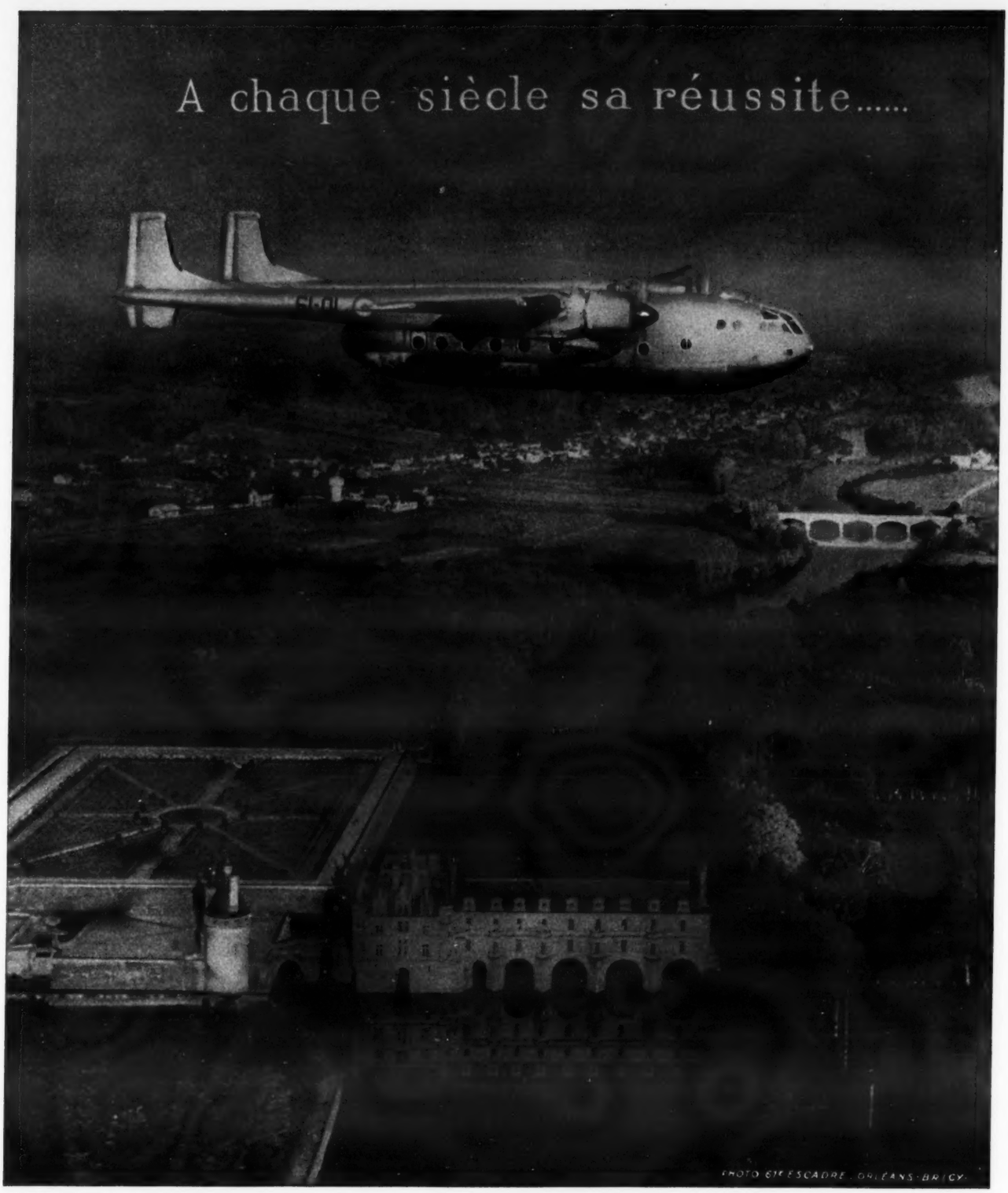
• **Vibro-Meter A.G.** (Fribourg-Moncor, Switzerland) : Complete metering, display and recording systems for the measurement of physical values.

★

During the period of the INTERKAMA Congress a series of " instrument courses " will be held to acquaint users with the qualities, operation and maintenance of measuring instruments. The courses, 84 in number, are being organized by 26 manufacturers, and will deal with 47 different subjects covering equipment for the following fields : data converters for physical values of all kinds, based on electrical and pneumatic operation ; electrical and pneumatic regulators for the most varied systems ; analytical equipment ; mechanical, electrical and photographic recording equipment, data storage equipment and electronic computers ; components.

* Internationaler Kongress mit Austellung für Messtechnik und Automatik.

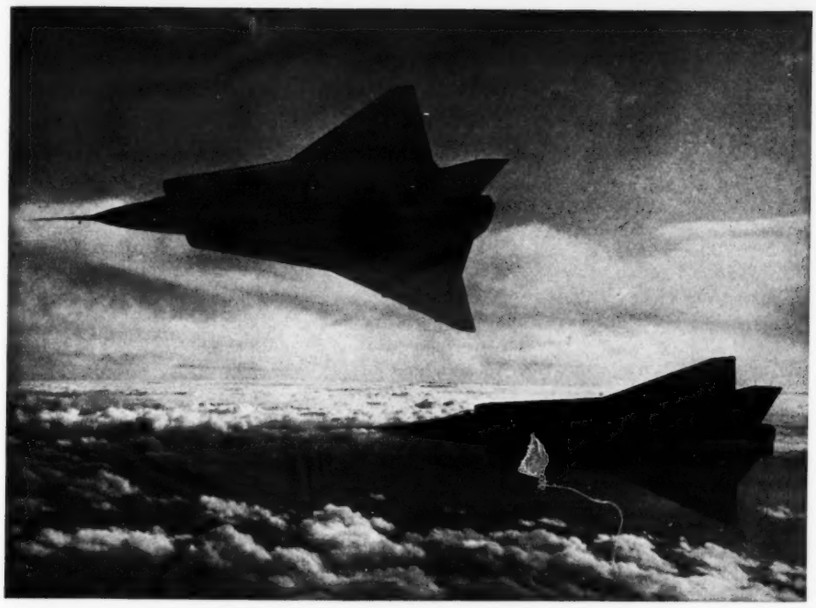

"The Middle East"
BRITISH MESSIER UNDERCARRIAGES
ON THE BRISTOL BRITANNIA



S.N.C.A.N

Société Nationale de Constructions Aéronautiques du Nord

2 à 18, RUE BÉRANGER - CHATILLON-S/S-BAGNEUX
(SEINE) TÉL. ALÉSIA 57-40

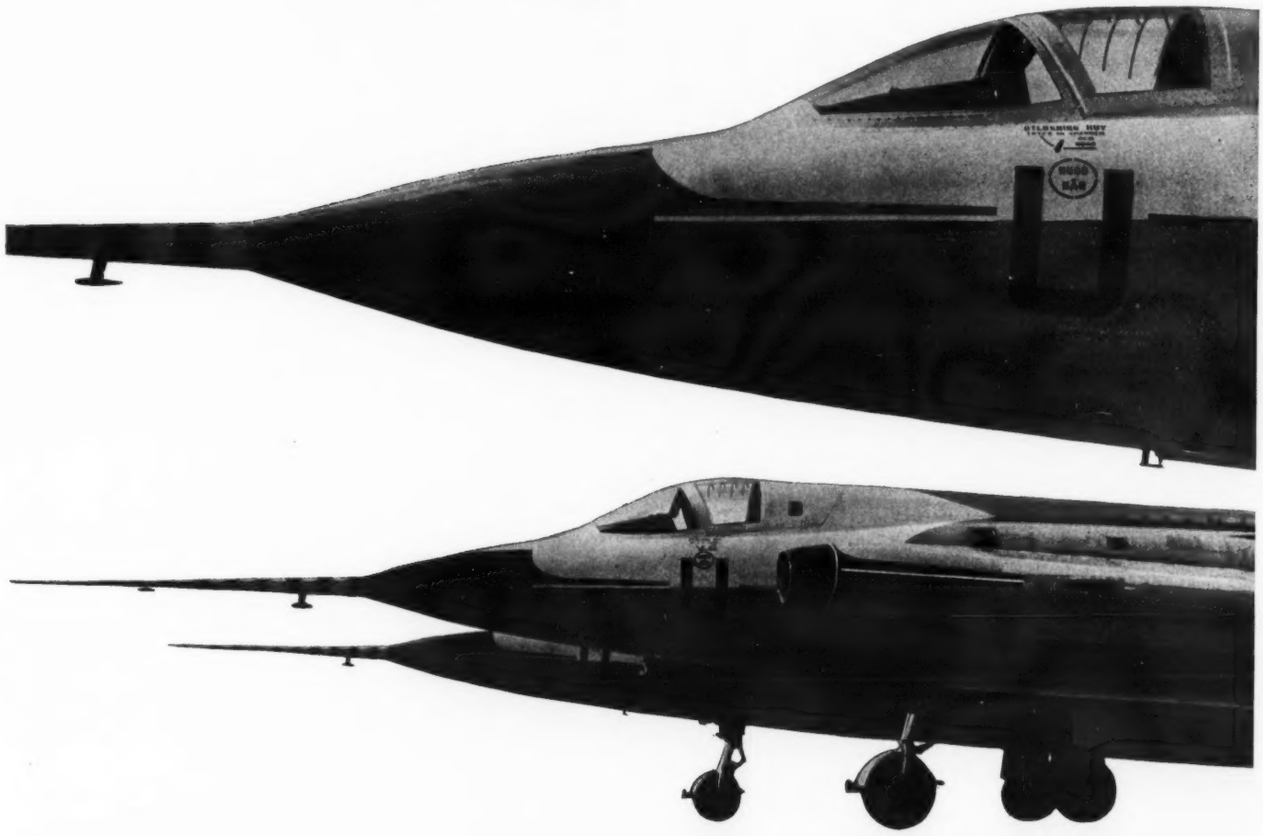


SAAB

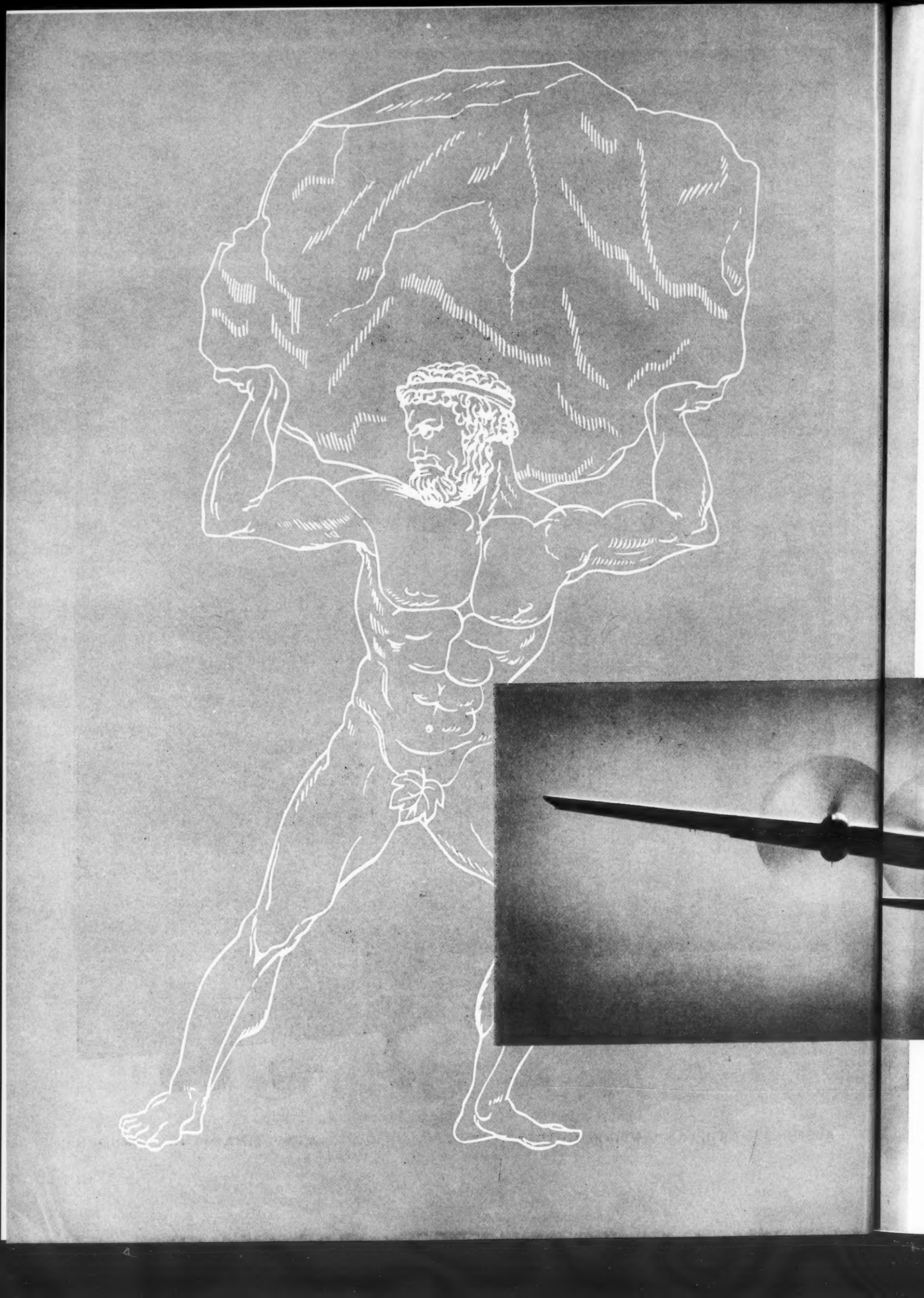
The Saab-35 " Draken " supersonic all-weather jet fighter is one of the most advanced aircraft in quantity production. It has a high supersonic top speed, a fantastic rate of climb and a very high operating altitude. Yet it can operate from relatively small airfields. The Saab-35 is powered by a Rolls-Royce Avon turbo-jet with afterburner, built in Sweden by Svenska Flygmotor. Its armament consists of cannon, rockets and guided missiles.

first supersonic jet fighter for the Swedish Air Force

SAAB J 35



SVENSKA AEROPLAN AKTIEBOLAGET *(SAAB AIRCRAFT COMPANY)* · LINKÖPING · SWEDEN



ANNOUNCING THE NEW LOCKHEED

HERCULES

–America's first prop-jet air freighter designed to transport the goods of the world in the Jet Age

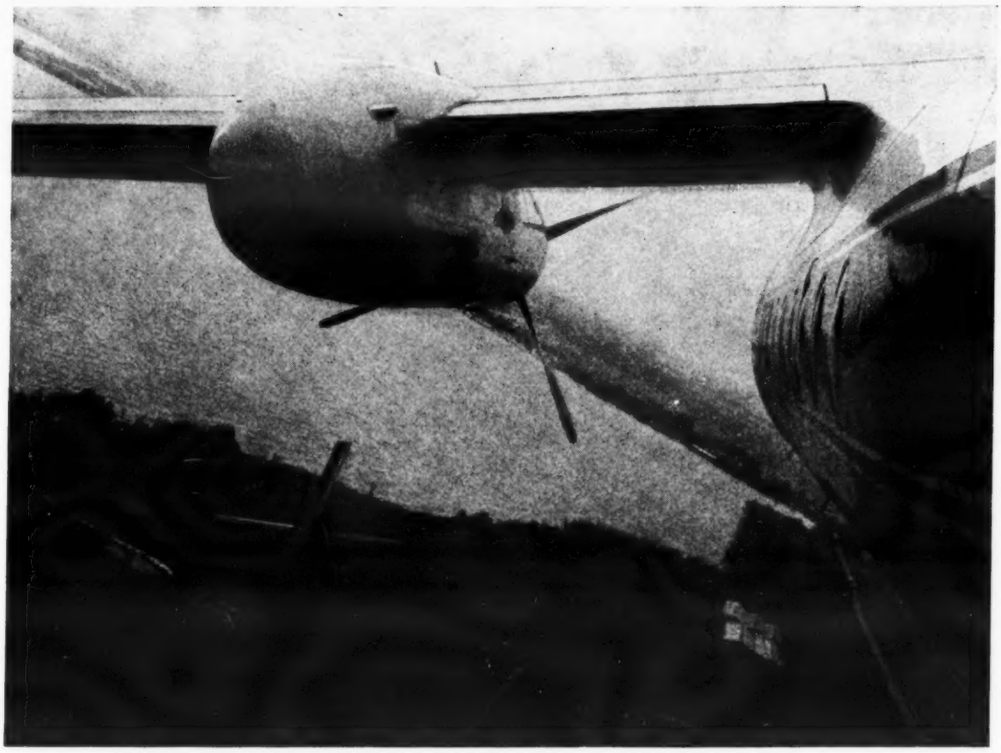
The new HERCULES air freighter is a more powerful, longer-range commercial version of Lockheed's military C-130—the performance proved "go any place, haul anything" combat cargo carrier of the U.S. Air Force.

The first Jet Age aircraft specifically designed for air freight, the new HERCULES has a huge rear loading door—enabling it to swallow whole truckloads of assorted cargo. No other commercial cargo plane now available can match the HERCULES in fast loading and unloading—of all types of cargo, no matter how big or heavy.

Powered by four 4050 h.p. Allison (General Motors) 501D prop-jet engines, the mighty HERCULES can take off from or land on short runways and improvised fields, fully loaded. Wherever air freight is needed, any place in the world, the HERCULES can get it there in a hurry, at a profit to airline operators.

GEORGIA DIVISION, *Lockheed Aircraft Corporation, Marietta, Georgia, U.S.A.*

LOCKHEED *means leadership*



Friendship

An unusual shot taken with an outboard camera during a single-engine flight of the Fokker F. 27 Friendship

FRIENDSHIPS ON ORDER BY :
AER LINGUS ; TRANS-AUSTRALIA AIRLINES ; DEPARTMENT OF CIVIL AVIATION/AUSTRALIA ; K.L.M., ROYAL DUTCH AIRLINES ; NETHERLANDS GOVERNMENT ; R.I.V./Turin ; BRAATHEN'S S.A.F.E. ; IRANIAN OIL EXPLORATION & DEVELOPMENT CO.; TRABAJOS AEREOS Y ENLACES; FRONTIER AIRLINES ; MACKEY AIRLINES ; WEST COAST AIRLINES ; PIEDMONT AIRLINES ; SOUTHWEST AIRWAYS ; BONANZA AIRLINES ; BUTLER AVIATION ; GENERAL TIRE & RUBBER CO. ; CONTINENTAL CAN CO. ; QUEBECAIR ; WHEELER AIRLINES ; WIEN ALASKA AIRLINES ; NORTHERN CONSOLIDATED AIRLINES ; BANCO DE MEXICO ; AEROVIAS ECUATORIANAS ; AVENSA.

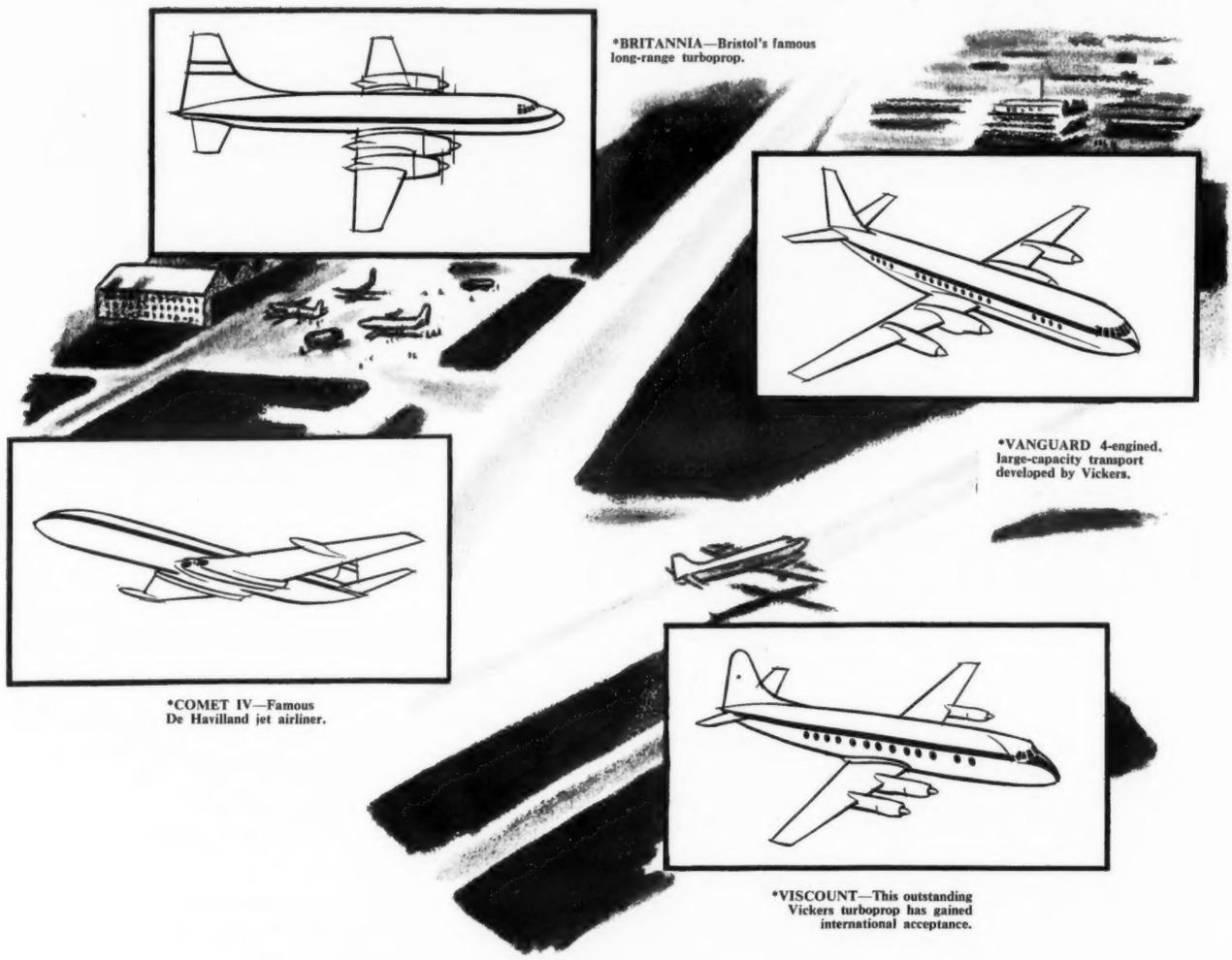
Fokker

More and more home and

overseas airlines are buying British aircraft

fitted with Dunlop Tyres, Wheels, Brakes

and Maxaret Anti-Skid Units *



*BRITANNIA—Bristol's famous long-range turboprop.

*VANGUARD 4-engined, large-capacity transport developed by Vickers.

*COMET IV—Famous De Havilland jet airliner.

*VISCOUNT—This outstanding Vickers turboprop has gained international acceptance.

40 International Airlines operating over 500 British Aircraft

RELY ON

DUNLOP

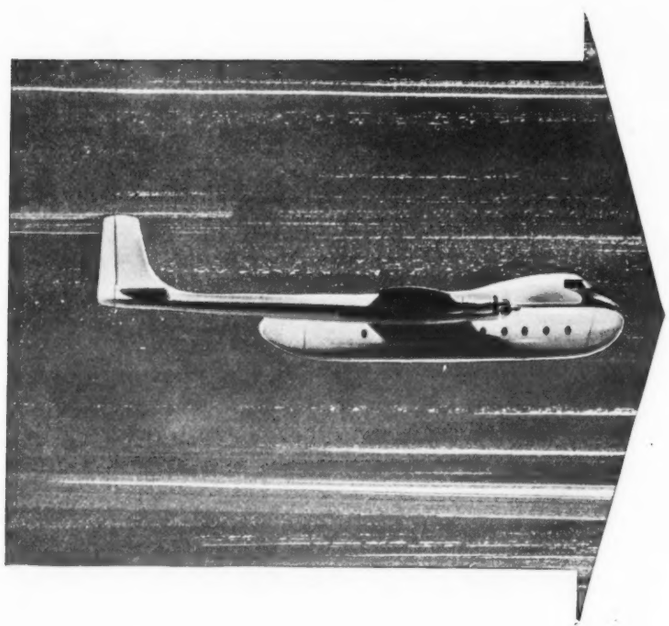
AIRCRAFT EQUIPMENT

DUNLOP RUBBER COMPANY LIMITED (AVIATION DIVISION), FOLESHILL, COVENTRY, ENGLAND

Depots throughout the world

THE WORLD'S FIRST PRESSURISED TURBOPROP

FREIGHTERCOACH ... the AW 650



Here is a modern adaptable transport specially tailored for freight and aircoach traffic in all parts of the world. No other aircraft is so versatile as this multi-purpose transport—the world's first modern pressurised turboprop freightercoach.

The aircraft has been designed to allow the greatest possible flexibility of operation with minimum time on the ground. The full-width fore-and-aft loading doors permit speedy terminal loading and easy cargo handling at intermediate stops. Four proved Rolls Royce Dart engines give the AW 650 a mean cruising speed on medium range routes of 300 m.p.h.

The AW 650 Freightercoach is a truly modern answer to world airfreight problems. It is robust, reliable and easy-to-maintain, and will achieve a substantial reduction of present airfreight costs. Alternative versions include a car ferry, a military transport and a short-stage bus. There is also a twin-engined version powered by Rolls Royce Tyne engines.

PAYLOAD	28,000 lb.
CAPACITY	3,680 c. ft.
SPEED	300 m.p.h.
TAKE OFF (field length)	4,050 ft.
RANGE	3,000 miles (without reserves)

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
Baginton, Coventry, England

MEMBER OF THE HAWKER SIDDELEY GROUP/PIONEER...AND WORLD LEADER IN AVIATION

U.S. Airlines and Aircraft Industry (early September 1957)

BY SCOTT HERSHEY, NEW YORK

Airline difficulties

New troubles are besetting the U.S. domestic airlines, already plagued with financial difficulties resulting from a profits pinch climaxing steady growth of operations and gross earnings, and denied an immediate six percent fare increase.

An anti-trust subcommittee of the House of Representatives has recommended that the Department of Justice investigate whether the nation's major airlines and their trade association, the Air Transport Association, have violated the anti-trust laws.

The subcommittee's Democratic majority said " a substantial number of A.T.A.'s activities for its member carriers involve serious antitrust problems ". The subcommittee sharply criticized operations of the A.T.A. and the Civil Aeronautics Board and called upon the C.A.B. to stop its " intimate association " with A.T.A. and to end the anti-trust exemption it had granted the association.

The Democratic majority said this exemption creates ambiguity as to the extent to which the activities of A.T.A.'s member carriers have been immunized from the anti-trust laws.

While citing what it said were C.A.B. shortcomings, the report said nonetheless " in the overall scope of its responsibilities the committee believes the board in general has done a good job ". However, it charged the board with " noteworthy failure " in not conducting a general investigation of airline fares to determine whether they are proper.

The majority report also accused the C.A.B. of failing to act against the practice of charging first-class fares for coach service, thereby " victimizing " the public and indirectly allowing an increase in coach fares. The subcommittee said it joined in recommendations by the Comptroller General for new regulations that would require the airlines to make automatic refunds when first-class fares are charged for coach service.

It also called on the C.A.B. to take action in adjusting the " disparity " between airline charges for carrying airmail and lower rates for comparable air freight. It found the C.A.B. " properly subject to severe criticism " for procrastination and working unnecessary hardships on non-schedule newcomers to the airline industry.

The Republican minority conceded that " a number of A.T.A.'s practices raise anti-trust questions ", but accused the Democrats of making a slanted presentation.

Stuart G. Tipton, A.T.A. President, said the report was " chockfull of vague hints and innuendo, signifying very little ". He said the industry's record since 1938 gives " positive proof it is not monopoly ridden ".

While the airlines were still digesting the 358-page report, a Soviet twin-jet Tu-104, the only type of jet in passenger service anywhere and the first Soviet airliner to fly to the United States, landed at McGuire Air Force Base in New Jersey, about sixty miles from New York.

The landing was made at McGuire after requests to use New York International Airport, Idlewild, had been refused. The refusal was in line with the Port of New York Authority's policy that neither jets nor turboprop aircraft might land at any of its four city airports unless they had passed a noise test.

In the past, requests to land at Idlewild have been denied to the Boeing 707, Britain's *Comet III* and an earlier *Comet*. France's *Caravelle*, the only two-engine jet airliner besides the Tu-104, has been cleared for landings at Port Authority fields. It was found in a test last spring to operate with a noise output comparable to that of four-engine piston planes in regular airline service. Turboprop aircraft such as the Vickers-Armstrongs *Viscount* and Bristol *Britannia* also have been cleared.

Boeing and other U. S. manufacturers have spent millions developing noise suppressors for their commercial jets. Boeing and Douglas have expressed confidence that the noise output will be no worse than the output of piston airliners by the time jet service begins here.

★

The U.S. industry, while acknowledging the Soviet Union's progress in this and other aeronautical fields, generally feels that the Soviet " commercial lead " is not real. Airline operators here say the Soviet jet, though of first-rate design and workmanship, is an economic monstrosity. They add that any airline dependent upon profits that tried to operate Tu-104s would rapidly go bankrupt. They cite as particular drawbacks of the Soviet plane its modest passenger capacity —50 to 70—and the inordinate thirst of its two engines.

Aircraft industry

A new jet development in the U.S. attracting attention is Lockheed's new small jet transport, the *Jetstar*, a swept-wing 500 m.p.h. 10-passenger aircraft, only eight months from drawing board to first test. The Air Force had indicated an interest in a small, swift jet transport that could be used for top priority military transportation. Lockheed, first company in a position to offer one, also plans to offer the *Jetstar* to private firms as a transport for company executives.

Grumman Aircraft Engineering Corp., re-entering the commercial aircraft market it left at the beginning of the Korean War, has announced a two-engine, 12-passenger transport designed for business firms. The first production aircraft is due off the line in May, 1958. It will be powered by two Rolls-Royce turboprop engines, will have a maximum cruising speed of 470 m.p.h. at 25,000 ft. It has a wing span of 78 ft., an overall length of 64 ft. and weighs 31,000 lb.

Among other manufacturers, United Aircraft Corp. first-half earnings were up 25.3 percent on a sales gain of 31.9 percent, compared with a year earlier. Net income for the first half was $ 25,747,810 after providing $ 29,005,240 for taxes. This was equal to $ 4.80 per common share and compared with $ 20,556,235, or $ 4.06 per share for the corresponding period last year when the tax bill was $ 22,269,254.

Shipments were $ 604,014,634, compared with sales of $ 458,471,149 a year ago. Government deliveries amounted to 85 percent of total sales against 87 percent a year earlier.

The mid-year report of Curtiss-Wright and its subsidiaries showed increased sales but little change in earnings. Net sales amounted to $ 313,341,963, compared with $ 279,147,270. Net income was $ 20,712,890, against $ 20,452,000. Roy T. Hurley, Chairman and President, said that about 65 percent of the half-year earnings had come from commercial sales.

All manufacturers were affected one way or another by the Defense Department's re-shaping of its budget. The Air Force is being called upon to reduce its rate of spending by $ 1,378,000,000 from the pace at which it is now meeting its bills. The Air Force has called upon private aircraft industries to cut payroll costs by 5 percent by October. However, companies doing ballistic missile work were specifically exempted.

The Air Force recently cancelled a jet aircraft project before a single model was flown and, a spokesman said, " after about $ 100,000,000 was spent on it ". The craft is the XF-103, made by Republic Aviation Corp. It was to have been powered by a complex Curtiss-Wright engine which the Air Force said it had no other use for at this time.

INTERNATIONAL MEETINGS AND CONFERENCES

Oct. 13th-20th : ASTA - 27th Annual Convention of the American Society of Travel Agents and World Travel Conference. Madrid.

Oct. 14th-26th : WMO - First Session of the Telecommunications Group, Synoptic Meteorology Commission, Paris.

Oct. 14th-Nov. 30th : ICAO - 2nd Regional Meeting, - South America - South Atlantic ICAO.

Oct. 16th-18th : AIEE - American Institute of Electrical Engineers - Conference on Computers in Control. Atlantic City, N.J.

Oct. 16th-18th : CIRE - Convention and Exhibition of the Canadian Institute of Radio Engineers. Toronto.

Oct. 16th-19th : NASAO - National Association of State Aviation Officials Annual Meeting. Sun Valley, Idaho.

Oct. 17th-18th : MA - 13th Annual Congress of the Magnesium Association. New York.

Oct. 17th-19th : NSE - Fall Meeting of the National Society of Engineers. Bismarck, N. Dakota.

Oct. 18th-27th : International Exhibition of Electricity and Atomic Energy. Copenhagen.

Oct. 20th-22nd : AHS - 4th Annual Western Forum of the American Helicopter Society. St. Louis.

Oct. 21st-22nd : IAS - Joint Meeting IAS and Canadian Aeronautical Institute. Montreal.

Oct. 21st-23rd : ASME - Conference on New Developments in the Fields of Power. Allentown, Pen.

Oct. 21st-25th : 45th National Safety Congress. Chicago.

Oct. 23rd-24th : ARF - Armour Research Foundation Computer Applications Symposium. Chicago.

Oct. 24th-25th : AES - 14th Annual Display of Aviation Electrical Equipment, Aircraft Electrical Society. Los Angeles.

Oct. 28th-29th : AUSA - 3rd Annual Meeting of the Association of the U. S. Army. Washington.

Oct. 28th-30th : Annual East Coast Conference of Aeronautical and Navigational Electronics. Baltimore.

Oct. 28th-31st : ANS - 2nd Winter Meeting of the American Nuclear Society. New York.

Oct. 28th-January 28th, 1958 : Industrial Exhibition and Trade Show. Rio de Janeiro.

Oct. 29th-30th : AFF - Ausschuss für Funkortung. Congress on Polar Coordinate Navigation Systems for Ships and Aircraft. Essen.

Oct. 30th : Exhibition of Aviation Electrical Equipment. San Diego, Calif.

Oct. 30th : ATCA - Annual Meeting Air Traffic Control Association. Indianapolis.

Oct. 30th-Nov. 1st : 2nd Annual Aviation Medicine Symposium, University of California. Los Angeles.

Oct. 30th-Nov. 5th : SAC - Annual Navigation, Reconnaissance and Bombing Competition organized by Strategic Air Command. Pinecastle AFB, Florida.

Oct. 31st : The 1957 Sir Alfred Herbert Paper, "The Bases of Measurement", IPE, London.

Nov. 1st-4th : ASA - National Congress of the Astronautical Science Association. Rome.

Nov. 2nd-8th : 2nd International Congress on Metallurgy. Chicago.

Nov. 2nd-10th : INTERKAMA - International Congress and Exhibition of Metering and Automation Techniques. Düsseldorf.

Nov. 5th-7th : Joint Military - Industry Guided Missiles Reliability Symposium. U.S. Navy Test Centre, Point Mugu, Calif.

International Airworthiness

by R. E. Hardingham, Chief Executive, Air Registration Board, London

One of the functions of the International Civil Aviation Organization is to produce an International Airworthiness Code for all transport aircraft operated on international routes, with the primary aim of protecting people on the ground of the countries over which the aircraft are flown. This aim, although of the greatest importance, has no regard to the interchange of aircraft between the manufacturing countries since it provides only a minimum standard of airworthiness and does not contain the amount of detail that is considered necessary in National Requirements.

The Contracting States of I. C. A. O. have never felt it possible to extend the Code so as to make it suitable as a standard for the sale of aircraft between the countries. Thus, while signatories to I. C. A. O. may incorporate the I. C. A. O. Code within their national requirements, there are still differences of some consequence in national requirements which have to be taken into consideration before certificates of airworthiness issued in one country can be validated by another country.

The countries mainly concerned in this matter are the United States of America and the United Kingdom, but so far the differences in their requirements have not presented any great difficulty when either the U. S. A. or the U. K. have sold aircraft to other nations of the world. Either the American or the British certificate of airworthiness has been generally acceptable to other nations.

Unfortunately, the same cannot be said for aircraft which are either sold by the U. S. A. to a British operator or by the U. K. to an American operator. The problems involved have become more acute in recent years because of the greater exchange of aircraft between the two countries and by the sale of British engines for installation in American aircraft or American engines for installation in British aircraft.

As long ago as 1934 an agreement for the reciprocal validation of certificates of airworthiness between the U.K. and the U.S.A. was made. This agreement permitted each country to require special conditions to be met by the aircraft before its certificate was validated. Before the last war these special conditions were restricted to a few points of major difference between the requirements of the two countries, and in 1948 the Civil Aeronautics Administration, after reviewing the then current British Civil Airworthiness Requirements, listed new special conditions and these were again amended in 1951 to take account of the differences which had arisen between the performance requirements of the two countries. The United Kingdom, on the other hand, cancelled its pre-war list of special conditions, and for a period accepted U. S. aircraft without qualification.

The post-war U. S. A. special conditions were confined in their application to piston-engined aircraft, and in 1952 the C. A. A. notified the Board that, pending the development of U. S. requirements for turbine-engined aircraft, validation of certificates of airworthiness for U. K. aircraft would be dealt with by ad hoc examination of each type. Thus, when *Viscount* aircraft were sold to Capital Airlines this policy was applied by means of the C. A. A. undertaking a design survey and imposing such additional special requirements as would, in their opinion, ensure that the aircraft in its export version would be acceptable to the U. S. A. The United Kingdom also examines U. S.-constructed turbine-engined aeroplanes on a similar basis.

This procedure has emphasized the many detailed differences which exist between the two sets of national requirements. It is of course desirable and mutually advantageous to revert to the type of procedure envisaged by the 1934 agreement when a small number of special conditions of a general character had to be met. This ensured that British and American constructors knew precisely what they had to do to achieve validation of their national certificates of airworthiness. The present state of affairs does not permit them to have such knowledge, and this is causing considerable difficulties.

Efforts are being made to solve these difficulties, and an exchange of diplomatic notes has taken place. It has been generally agreed that a detailed comparison of the appropriate requirements in the current United States Civil Air Regulations and the British Civil Airworthiness Requirements should be made, and the Board has practically completed such a study. It entails a line-by-line comparison with an appraisal of the various differences, and the Air Registration Board hopes that it will result in mutual acceptance of each country's national airworthiness code where the differences are relatively unimportant, leaving only a few special conditions to cover the more significant differences between the two national codes.

By this means it is hoped to reduce the differences to an absolute minimum and then for these differences to be published as conditions to be met by all aircraft exported to the U. S. A. and vice versa. On the long-term issue the Air Registration Board hopes to meet the appropriate authorities in the U. S. A. at least once a year to avoid the growth of differences between the U. S. and U. K. requirements.

Thus, hopes are reasonably high that some arrangement can be made so that manufacturers in each of the two countries will have a reasonably clear and comprehensive idea of what is required at a very early stage of manufacture. At any rate the work that is now being done should be a major step towards this aim.

Correction

In the article entitled "Flying the Atar Volant" in **Interavia's** July issue, the author, Auguste Morel, stated that Lucien Servanty had been responsible for supervising the P.1's testing on the gyroscopic bench and in the rig. In actual fact, these tests were directed by Pierre Servanty; his brother, Lucien Servanty, Sud-Aviation's Chief Engineer, is the "father" of the **Trident.**

Photo credits : Front cover : Saunders-Roe ; pp. 998-1002 : Michelet, Paris (4), manufacturers (5), Interavia (36); p. 1003 : Interavia files ; pp. 1009-1011 : manufacturers (12), Interavia (24); pp. 1012-1014 : J. P. Darmstätter (1), manufacturers (8), Interavia (22) ; pp. 1015-1016 : Intercontinental Hotels Corporation; pp. 1021-1022 : manufacturers; p. 1023 : manufacturers ; pp. 1024-1025 : manufacturers ; pp. 1026-1028 : de Havilland Gazette (2), manufacturers (5) ; pp. 1037-1039 : manufacturers (5), Interavia files (4) ; pp. 1040-1041 : author ; pp. 1042-1044 : R.C.A.F. (2), Sabena (1), U.A.L. (1), manufacturers (10), Interavia files (8) ; pp. 1053-1056 : G. de Aquilar Portillo, Madrid (42) ; pp. 1057-1058 : I.C.A.O. (2).

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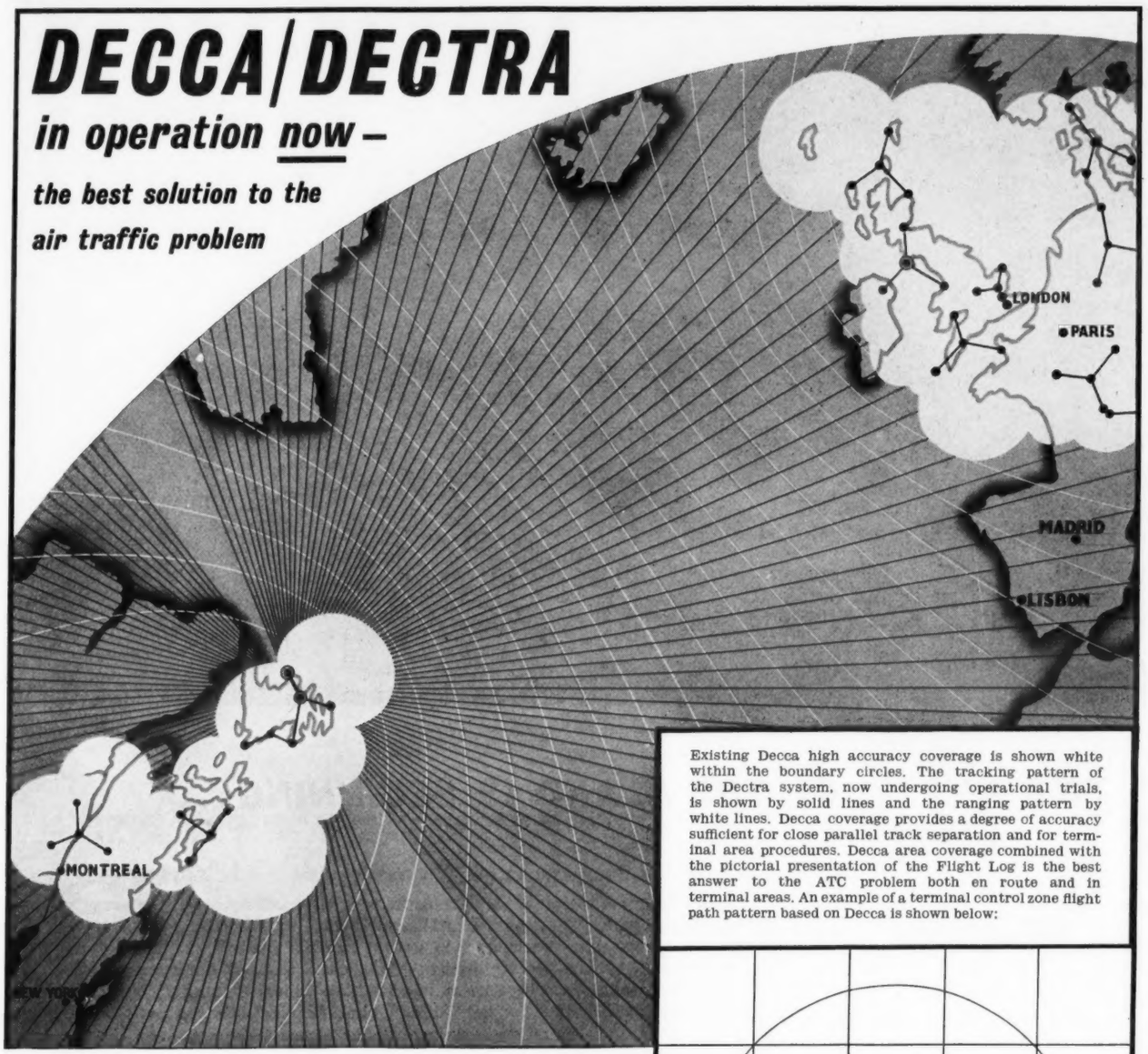
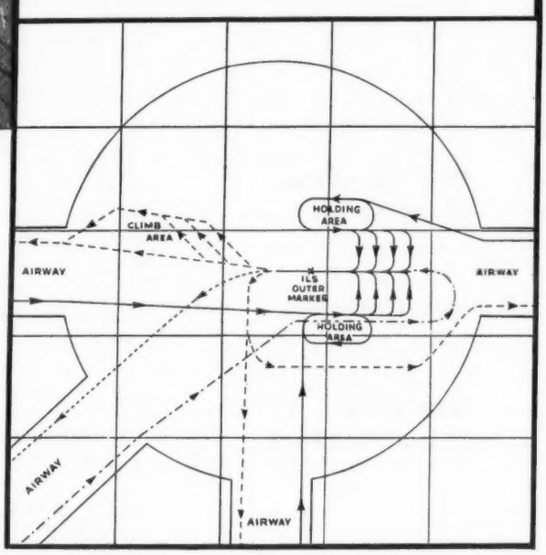
the best solution to the air traffic problem



Existing Decca high accuracy coverage is shown white within the boundary circles. The tracking pattern of the Dectra system, now undergoing operational trials, is shown by solid lines and the ranging pattern by white lines. Decca coverage provides a degree of accuracy sufficient for close parallel track separation and for terminal area procedures. Decca area coverage combined with the pictorial presentation of the Flight Log is the best answer to the ATC problem both en route and in terminal areas. An example of a terminal control zone flight path pattern based on Decca is shown below:



Precise control of air and sea traffic can be accomplished today by the use of Decca/Dectra the proven high accuracy area coverage system.

DECCA/DECTRA is the only navigation system providing high accuracy local coverage at any altitude with medium and long range parallel track facilities using the same airborne equipment.

DECCA/DECTRA is the only system which provides pictorial presentation.

DECCA/DECTRA is the most economical system in the world both in cost and in use of frequencies.

The report of the Jet Operations Requirements Panel of ICAO meeting in Montreal in June 1957 has this to say:

"Some existing systems of navigation used for medium and short range flights provide the possibility of accommodating present air traffic, including turbine-engined aircraft, although in some cases with difficulty. However, increasing traffic densities plus the special requirements for optimum operation of jet aircraft, as outlined in the ATS section of this report, lead to the conclusion that an area type of navigation aid will be necessary in the near future.

The Panel recommends the adoption of an accurate and reliable short-range navigational aid based on the area coverage system and designed to provide pictorial presentation to the pilot in the cockpit. The Panel further recommends that the Sixth Session of Communications Division should consider this recommendation as a matter of urgency."

Over 4,000 ships and aircraft are fitted with the Decca System which has been in operation for over 11 years.

DECCA/DECTRA

the world's most accurate navigation system

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THE ERA OF THE ELAND IS BEGINNING...

The Fairey Rotodyne combines the essential features of the helicopter and the autogyro. Powered by two specially designed ELAND turbo-props it will carry 10,000 lbs. over 400 miles at speeds up to 170 m.p.h. Why was the ELAND chosen?
The Rotodyne ELAND is basically similar to the standard ELAND, but has an auxiliary compressor mounted co-axially at the rear. Power is taken through the auxiliary compressor for vertical flight, and through the propeller for forward flight. Like the standard ELAND, the Rotodyne ELAND has all the advantages of single-spool simplicity, plus . . .

New standards of safety

The ELAND is controlled by a single lever with a manual over-ride and three safeguards against overspeeding and overfuelling. Fuel is metered accurately and automatically to the pre-determined needs of the turbine.

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This safety margin gives the ELAND a highly flexible operational range. It can be guaranteed to work at maximum efficiency under *every* operational condition.

New ease of maintenance

ELAND power comes in four self-contained units which are quickly and easily removed. Long overhaul life of the engine keeps the number of base spares required to the minimum.

The ELAND has high aerodynamic efficiency, low specific weight, low specific fuel consumption. It is the most economical answer to many of the urgent problems of air transport—rotary and fixed wing alike.

How are you going to use the Eland to your advantage?

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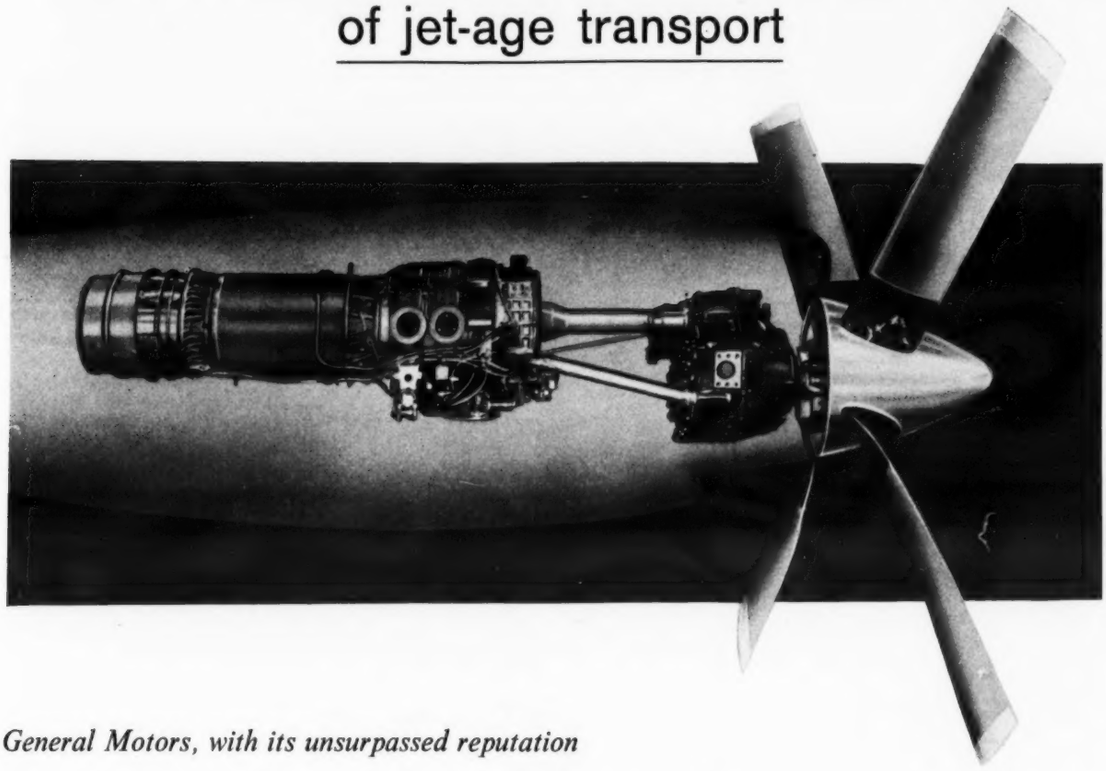
LOOK TO A FAMED NAME

for the answer to the new economy needs of jet-age transport



General Motors, with its unsurpassed reputation for technical skills, now brings you the economical, matched team for the jet-age — Allison Prop-Jet Engines and Aeroproducts Propellers.

To the men who are blazing new jet pathways around the world, economy of operation has become an ever increasing challenge.

To the earning power inherent in Prop-Jet transports, *a new plus has been added.* In the Lockheed Electra, Allison Prop-Jet Power offers *more* economy of operation than any other prop-jet engine of today.

● With instant thrust available from its Aeroproducts Propellers, this truly modern Prop-Jet engine makes Electra landings and take-offs possible from today's airports — and with no loss of income through off-loading of passengers to meet short runway or hot-day requirements.

● An engine as new as tomorrow, Allison Prop-Jet Power enables the Electra to fit into today's air traffic patterns *without special requirements* in *altitude* or length of trip.

● The Electra — with Allison Prop-Jet Power — is a *cost-saving airplane* which combines jet-age speed and luxury to win the passenger — and *earn a comfortable profit* for the operator.

● Allison Prop-Jet Power is the *economical* power for the jet-age in air transportation. And it carries the name General Motors — *a mark of proved quality and performance, the whole world over.*

Allison Division of General Motors

In the C-130, as in the Electra — Airframe by Lockheed

ALLISON PROP-JET POWER

Power plant by Allison Division of General Motors

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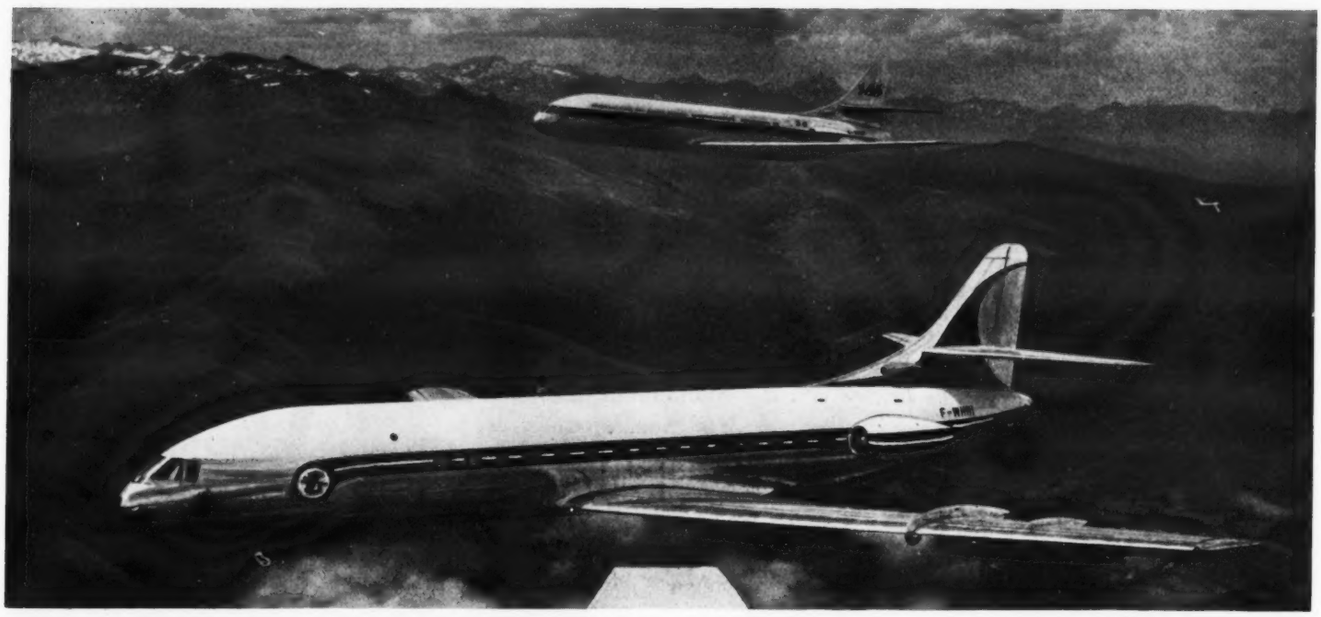
SUD AVIATION

congratulates two leading companies for selecting their long and medium range jets and establishing

THE JET ERA

DOUGLAS DC8 **LONG RANGE** BOEING 707



MEDIUM RANGE : Unanimous choice

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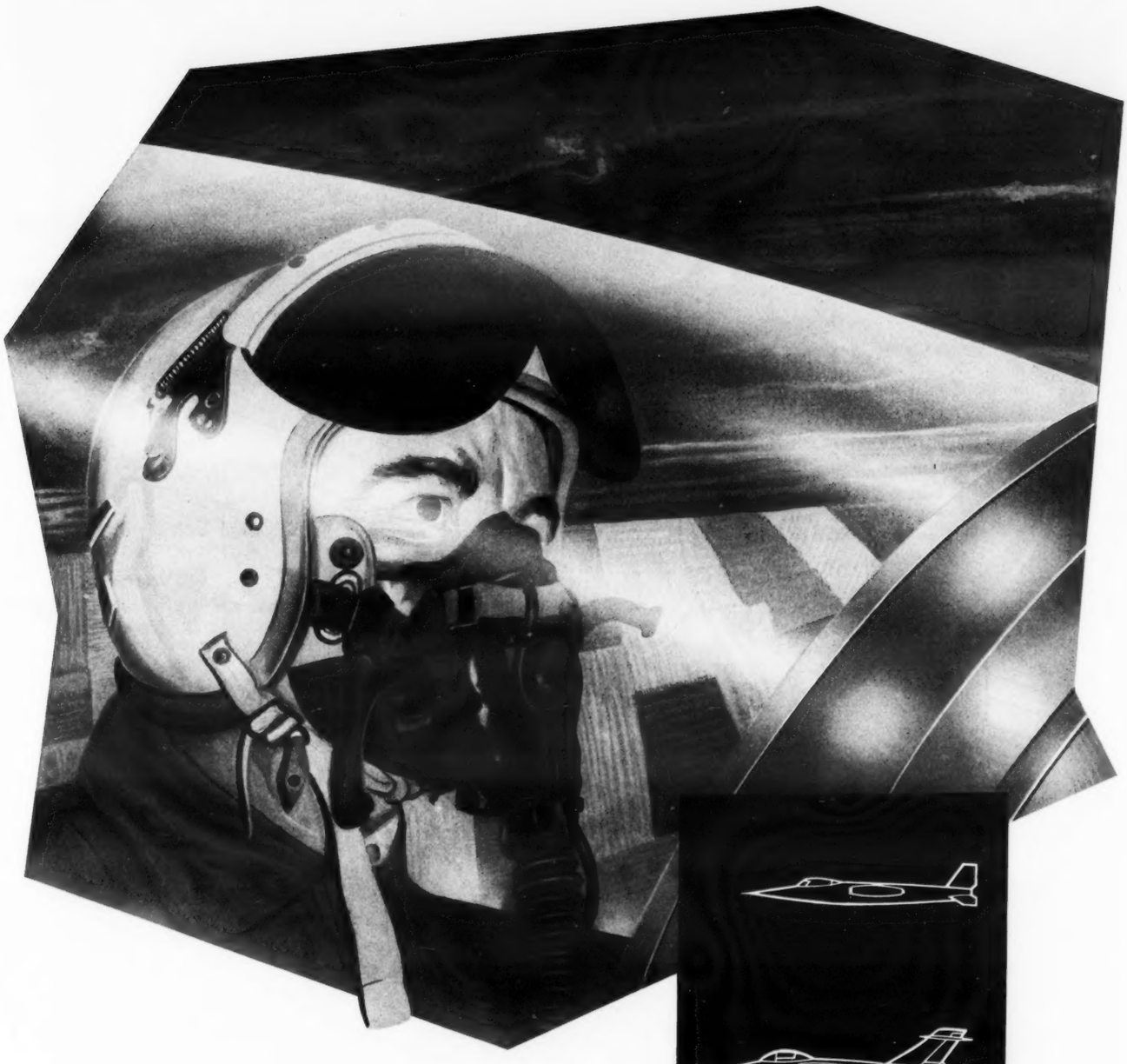

THE TRIDENT II

light interceptor, an experimental batch of which has been ordered, will exceed twice the speed of sound and can use hastily prepared airfields. It is armed with an air-to-air missile carried beneath the fuselage.

THE BAROUDEUR

single-seat tactical support aircraft, powerfully armed and highly manœuvrable, takes off, lands and manœuvres on skids on all terrains.

THE VAUTOUR

twin-jet combat aircraft ordered in large numbers by the French Air Force, in its 3 versions — all-weather fighter, ground attack and bomber.

SUD-AVIATION

SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES

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LES TURBO-RÉACTEURS

ATAR

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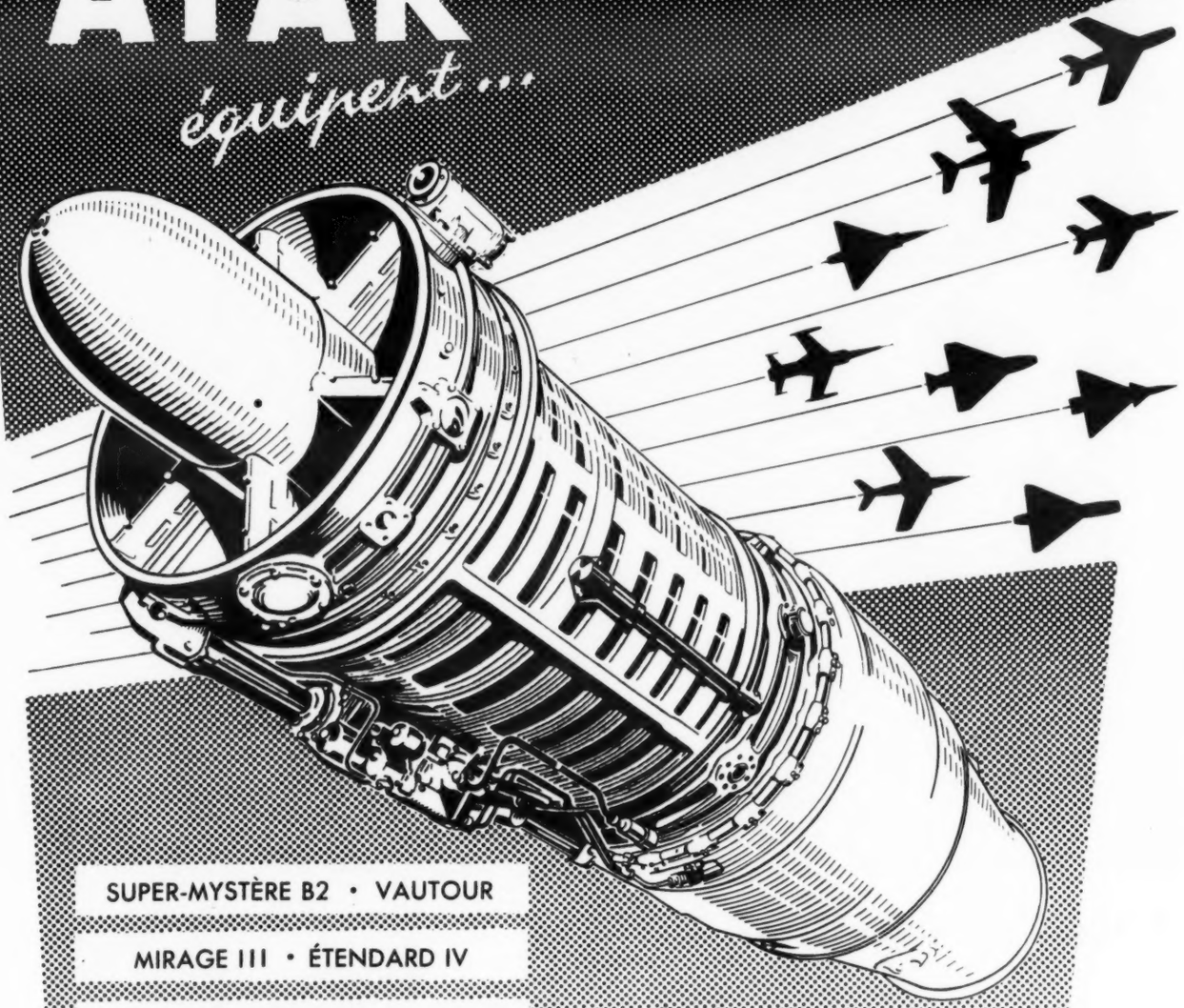

SUPER-MYSTÈRE B2 • VAUTOUR

MIRAGE III • ÉTENDARD IV

LEDUC 0-22 • GERFAUT • GRIFFON

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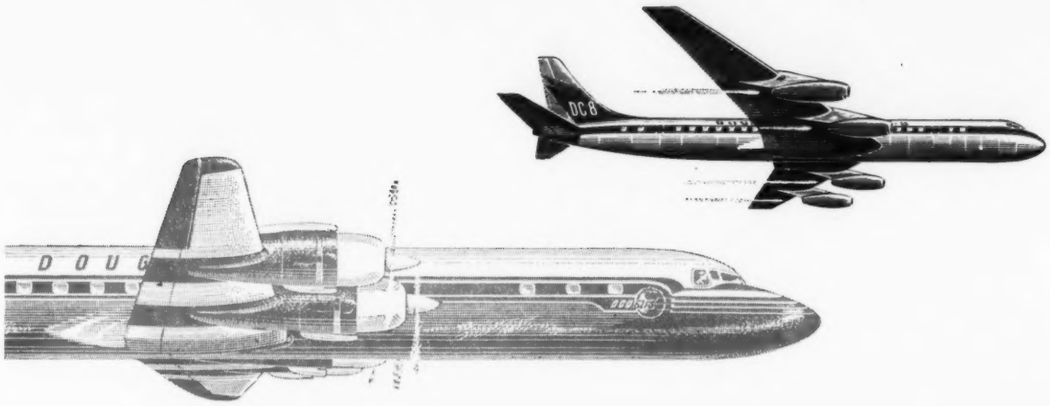


Douglas calls them the DC series . . . airline operators call them **THE PROFIT MAKERS!**

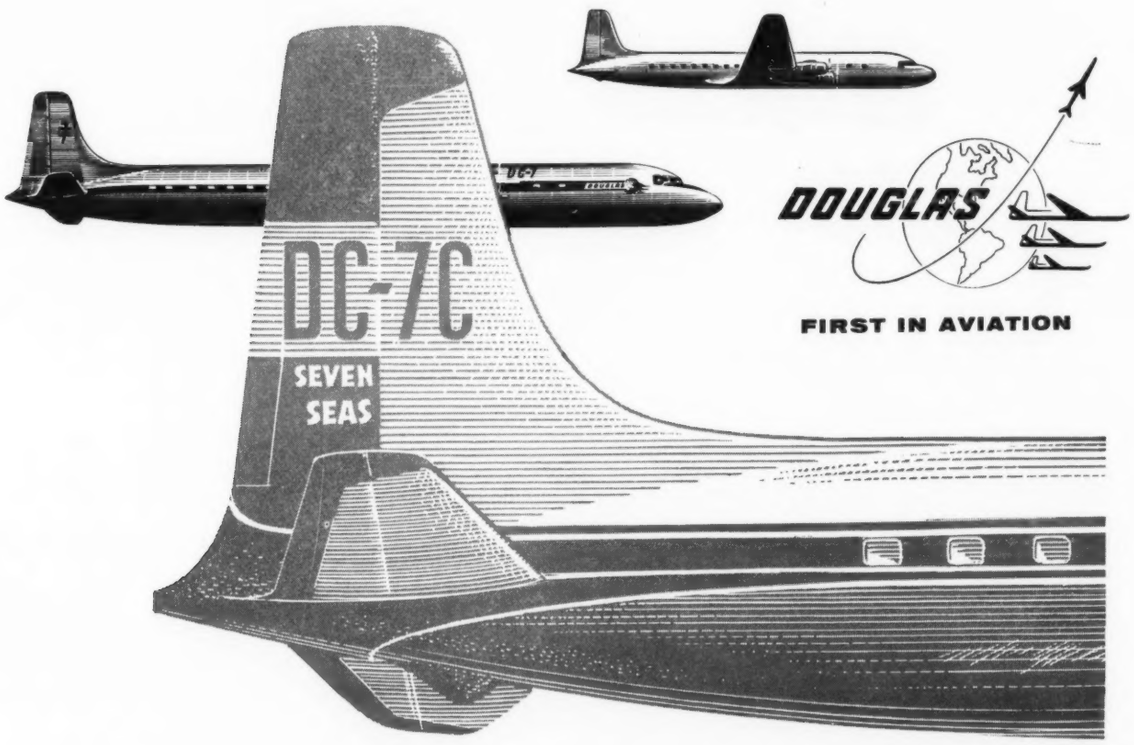
There are basic reasons why the use of Douglas equipment results in higher profits for airlines.

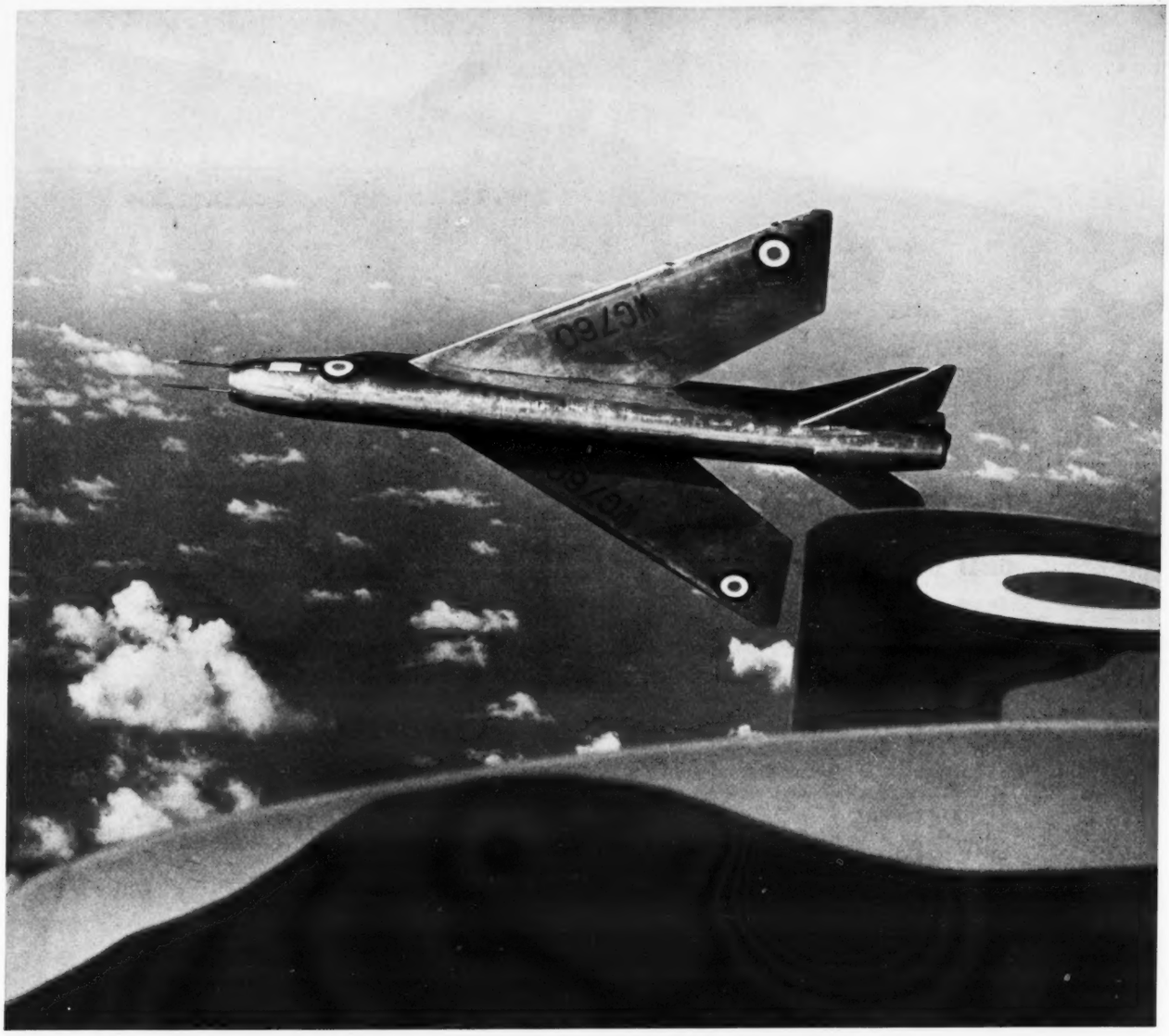
One is high utilization. This results from the outstanding reliability of the aircraft, their high speed and their low proportion of ground time because ease of maintenance is built right into the design.

Another is high payload and low cost of operation. This again is a function of design, relating to the low drag and high lift characteristics of the clean airframe and the engine's efficiency.

The long life of Douglas equipment also is an important asset. Completely written-off Douglas airplanes—some more than 20 years old—are still flying regular airline schedules all over the world.

Add to the above the world-wide preference for Douglas on the part of air passengers and you can understand why 9 out of 10 profit-making airlines depend on Douglas airplanes.





WHAT'S THE P.I. LIKE AT TRANSONIC SPEEDS?

As a result of all the research and development work done at Warton, the P.I. is stable and manœuvrable in the subsonic, the supersonic and even the tricky transonic, speed ranges.

Design starts from an attitude of mind

'ENGLISH ELECTRIC' aircraft

A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP

Los mismos perros con distintos collares*

No diplomatic phraseology can hide the fact that the "disarmament talks" which began in London's Lancaster House on March 18th, 1957, between five leading members of the United Nations—United States, Soviet Union, Britain, France and Canada—had become hopelessly bogged down by September 6th. Whether or not the talks are resumed in the U.N. Assembly after October 1st . . . for the moment it has not been possible to bridge the gap separating Western from Eastern views on atomic disarmament and the control of this disarmament from the air and on the ground.

Meanwhile public opinion is becoming indifferent to platitudinous official utterances. The world has become weary of hearing about fruitless discussions around the conference table. In 1899 Czar Nicholas II of Russia sponsored the first Hague Peace Conference whose official aim was world disarmament; the years 1932 to 1935 saw the League of Nations' disarmament conference meet with the same lack of success; and the recent London talks are only one example among many of the efforts made in the direction of disarmament since World War II.

Los mismos perros con distintos collares . . . The differences between Geneva in the thirties and London in 1957 are smaller than might appear; indeed the two present certain analogies on which statesmen would do well to meditate.

In organizing talks aimed at "general armament limitation" after World War I, the Western Allies were moved less by fear of an increasingly powerful and menacing armament potential than by the desire to prevent Germany, branded as an aggressor, from engaging in a new rearmament drive. Part V of the Treaty of Versailles laid down that Germany should sharply curtail her military power on land and at sea and be completely disarmed in the air. Some ten years later, when the tedious disarmament discussions began in the League of Nations, a curious situation arose: the United States, at that time dominated by the isolationists, appeared indifferent. The Soviet Union, fully occupied with rebuilding its armed forces, only gradually became interested in the Geneva talks. But France, to a certain extent Britain, and Italy actively entered the lists. France, with her satellite *bloc* of Little Entente countries, was anxious to maintain her military hegemony, in particular in the air. Britain was trying to catch up on her somewhat neglected air armament, and the then Fascist Italy was motivated by similar desires. Vanquished Germany, on the other hand, demanded the general disarmament to which she was theoretically entitled under the Treaty of Versailles and argued strongly—but of course in vain—for a ban on air, gas and bacteriological warfare.

Henri Bouché, today the French Government's representative on the I.C.A.O. Council, could testify from personal experience to the disappointments suffered at the old Geneva disarmament conferences. Along with a group of friends, he had prepared a plan for the "internationalization of military and civil aviation", the failure of which signified the end of the discussions, despite the high ideals which had motivated the proposal. When it came to defining the characteristics of a bomber of those days—and the same applies to a present-day bomber—the answer was found to be obvious: the highest possible speed with the greatest possible range and the highest possible payload. Unfortunately, these were exactly the same qualities as were demanded of the commercial transports then in their infancy or on the drawing boards. If Germany had built commercial aircraft of this kind—as she actually did in the Ju 52—she would have acquired a commercial fleet of "camouflaged" bombers. Ultimately, then, it was the aviation problem which caused the League of Nations disarmament talks to break down.

Today—and here ies the analogy—it is again aviation, quite independently of the introduction of nuclear weapons, which has upset the calculations of the disarmament advocates. Fundamentally, the men assembled around the conference table are much less interested in obtaining a ban on nuclear weapons or a halt to atomic tests and, more recently, intercontinental missiles with atomic warheads . . . than in the problem of maintaining the ban through inspection from the air and on the ground, as proposed by President Eisenhower in the summer of 1955, once again in the League of Nations city of Geneva. Now, as then, no country, however insignificant in the international political lists, shows the slightest inclination to accept any limitations on its sovereign rights in the air and on the ground—least of all the Soviet Union.

*

Such was roughly the situation when Russia officially announced, with becoming propaganda, at the end of August 1957 that she was in possession of a proven intercontinental ballistic missile. The United States' reaction was an equally official announcement that American long-range missiles had been launched with similar successes. Britain appointed herself third member of the "H-bomb club" and at Farnborough presented the aviation world with a dozen rockets and guided missiles. The Lancaster House delegates thereupon politely shook hands and departed.

What is the inevitable impression of the man in the street, either in Moscow or in Washington, under these conditions? He cannot help feeling that though Messrs. Dulles and Khrushchev talk a lot about disarmament, they formulate their demands in such a way that they are almost bound to be rejected. During the diplomats' verbal battles, the military must maintain a state of readiness, and ordinary mortals are beginning to get the jitters, since they no longer understand where all the talk is leading. Anyway the world has again reached an impasse, and Raymond Aron, leader writer for the Paris "Figaro", has defined the situation fairly clearly: "At the moment, these most fearful weapons are pure propaganda instruments".

*

The S.B.A.C. Display at Farnborough had scarcely closed its doors when leading executives of the world's airlines gathered in the Spanish capital for their annual meeting (September 9th to 13th). Readers will find a report on the Farnborough show (September 2nd to 8th) in the following pages and an account of the Madrid meeting later in the issue.

During both events the thinking observer could detect the same political development. When the airline bosses assembled for the I.A.T.A. Annual General Meeting in New York's Waldorf-Astoria just two years ago, the American Juan T. Trippe of Pan American World Airways and the Frenchman Max Hymans of Air France, as well as Britons and others stood up to a man to proclaim that the Russians should be at the same table, their place in the International Air Transport Association was being kept for them, and the airlines of the rest of the world would welcome an opportunity of working as colleagues with Russia's Aeroflot. A year later at Edinburgh, the Russian Air Attaché to the Court of Saint James attended the I.A.T.A. discussions as a welcome observer.

While this year's meeting was taking place in Madrid, the first Russian jet airliner landed with a Russian U.N. delegation at a military base near New York. In Madrid, the only Russian flavour was provided by . . . the caviar.

EEH

* Spanish proverb: "The same dogs with different collars".

FARNBOROUGH — Shopwindow for British Civil and Military Production

The 18th S. B. A. C. Exhibition

When reviewing last year's S.B.A.C. Show, *Interavia* predicted that the 1957 Exhibition would bring surprises, and this forecast has been realised. Numerous new technical developments in all fields and, of almost equal importance, significant progress in the continued development of existing designs and products. This was the first impression from a visit to Farnborough 1957. But over and above this the British aviation industry appears to have been quick to appreciate, in greater or lesser degrees, the greatly changed situation brought about by the White Paper on Defence, and to plan to overcome the setbacks caused by the draconic change in armaments policy.

There remains however the question whether this summary impression may overlook the manifold difficulties facing the leading engine and airframe manufacturers, and if the detrimental effects of the White Paper may not be felt more keenly in the course of the next few years? Many promising military projects which have been of profit to the civil industry have had to be abandoned or at least cut back. Many firms have been forced to readjustments which initially, instead of permitting economies, have entailed increased costs. Nevertheless, taking the wider view, there is no call for undue pessimism. With their resources of technical know-how and the clear-sightedness of the responsible men, the British undertakings will not only tackle the new tasks laid down for them by the military planners, but will continue their drive in the civil market. Farnborough 1957, in any case, provided evidence that Great Britain is determined to maintain her place as the leading European air power.

*

Entrance to a spaceship? The nose of the Handley Page *Victor B. 1* V-bomber.

The central attraction: Saunders-Roe SR. 53 with mixed propulsion (Armstrong Siddeley *Viper* plus de Havilland *Spectre*), forerunner of the Saunders-Roe P. 177 interceptor.

What in fact did Farnborough have to offer roughly 7,000 foreign visitors? The list is impressive: eight new types of aircraft; seven guided weapons exhibited for the first time, most of which are in production; no less than seven new jet, turboprop and rocket engines for aircraft power, quite apart from rocket motors for guided weapons and an impressive list of auxiliary power units; five flying test-beds; and, by no means last, a wealth of new developments in the equipment section. However it is not only the large number of new designs which was important. It is clearer than ever that all these projects conform to a methodical plan and that some, at least, give promise of becoming successful production items. This holds good not only for equipment, but also for many new prototype aircraft.

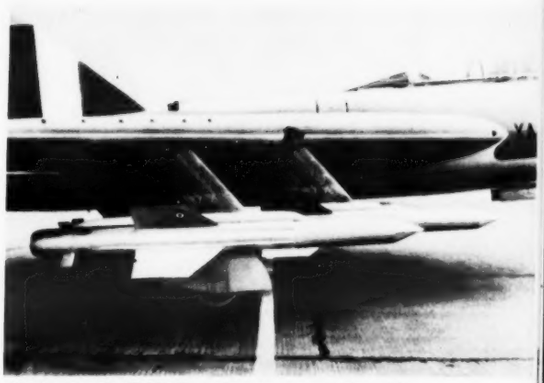
The focal point of both the Static Show and the Flying Display was the appearance of two fighter prototypes, of widely opposed designs, whose future prospects are regarded equally favourably; the Saunders-Roe SR. 53 mixed power lightweight fighter (with Armstrong Siddeley *Viper* jet and de Havilland *Spectre* rocket motor), forerunner of the Saunders-Roe P. 177 supersonic interceptor, and the English Electric P. 1B all-weather supersonic fighter (with two Rolls-Royce *Avons*). Among the foreign visitors the size of the West German delegation was second only to the American, and one reason for this is probably the German Air Force's interest in the SR. 53: short take-off and landing combined with high rate of climb—characteristics which are achieved in medium weight aircraft only by the use of mixed propulsion—are factors of great importance for the air arms of the smaller States where defence in depth is not possible. The defence of Great Britain, apart from the use of guided weapons, will call first on the P. 1B, which has now become the most decisive weapon in Britain's air armament.

Of the three V-bombers the Avro *Vulcan* has without doubt undergone the most striking modifications in recent years. In the latest version, the *Vulcan B.2* with enlarged wing area and yet another wing planform, this delta-wing bomber gives promise of even better high-altitude performance; and, with Bristol *Olympus BOl. 200* jets, is likely to remain the fastest of the British long-range manned bombers. The Handley Page *Victor B.1*, with four Armstrong Siddeley *Sapphires*, probably has an equal performance. Both these bombers, and also the *Valiant*, can be converted into tankers within a matter of hours, and can thus be utilized to increase the range and mobility of sister aircraft acting as atom and H-bomb vehicles. The Vickers *Valiant B. 1*, production of

Dowty main undercarriage for the Saunders-Roe SR. 53.

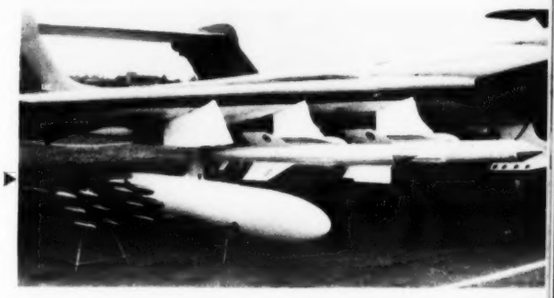
Avro *Shackleton MR. 3:* fuselage nose with twin cannon.

Contra-rotating four-blade propellers on the Fairey *Gannet T. 5.*



Gloster *Javelin FAW. 7:* under-wing suspension of two *Firestreak* air-to-air missiles on either side.

◀ Second, fully pressurized prototype of the Handley Page *Herald.*



Military load of the de Havilland *Sea Vixen* carrier-based supersonic fighter: four *Firestreak* missiles plus two auxiliary tanks, or two auxiliary tanks plus two rocket launchers containing a total of 24 unguided rockets. ▶

which has recently been phased out, will also render Bomber Command valuable service for some time to come.

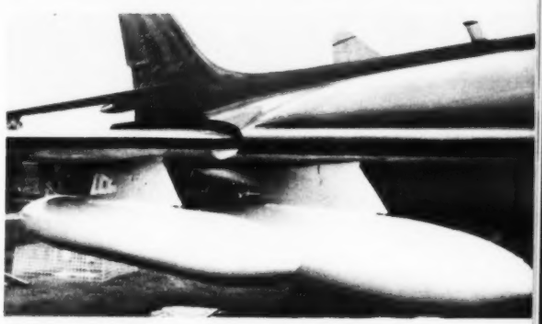
In the military aircraft export field the outstanding interest lies with the Hawker *Hunter F.6* interceptor which, in different versions with varying external loads (*Firestreak* and *Fireflash* air-to-air missiles, long-range tanks, etc.), took equal place as a highlight of the Flying Display.

The *Javelin FAW.7* twin-engine all-weather fighter—now also armed with the *Firestreak*—also showed modifications to the 1956 design (longer fuselage, pylons for under-wing military loads etc.) and at the same time has been re-equipped with *Sapphire* jet engines for greater power. De Havilland showed the second production version of the *Sea Vixen FAW.20* carrier-borne supersonic fighter; like other all-weather fighters of the same weight class, the *Sea Vixen* impressed with its extensive and varied military loadings. The Vickers Supermarine *Scimitar* supersonic naval fighter is also now in quantity production; and the size of the four auxiliary fuel tanks suggests remarkable range. Judging by the flying display the extensive external loads employed on these fighter aircraft in no way impairs performance or controllability at near-sonic speeds.

Mention must also be made of the outstanding demonstrations given by the Hunting Percival *Jet Provost* and Miles M.100 *Student* jet training aircraft; and the Fairey *Gannet AS. 4* anti-submarine aircraft, all of which are shown in the accompanying pictorial report. It is noteworthy that for the first time the Royal Navy participated in the Flying Display with five Hawker *Sea Hawks* and twelve Fairey *Gannets*, and also showed new anti-submarine weapons. The helicopter display included the Bristol *Sycamore* and Bristol 173, Fairey *Ultra-Light Helicopter*, Saunders Roe *Skeeter*, Westland *Whirlwind* and *Widgeon*, as well as the new gas turbine anti-submarine Westland *Wessex*.

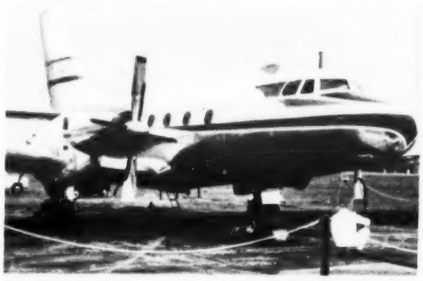
The flying test-beds *Orion-Britannia, Conway-Vulcan, Olympus-Canberra, Gyron Junior-Canberra, Spectre-Canberra, Scorpion-Canberra,* and the reverse thrust *Hunter* left no doubt that the

Hunting Percival *Pembroke* multi-purpose and communications aircraft in a version for the German Air Force.



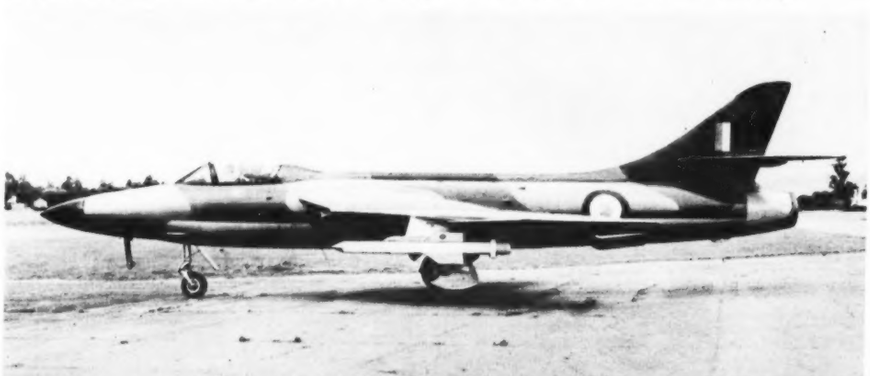
Vickers Supermarine *Scimitar F. 1* with four external tanks; air-to-air or air-to-sea weapons can be carried in place of the latter.

A new-comer to Farnborough: the Aviation Traders *Accountant* short-stage commercial transport (two Rolls-Royce *Darts*).



Scottish Aviation *Twin Pioneer* as "bush bomber", in front of an imposing array of military loads.

Export item Number One: Hawker *Hunter F. 6* interceptor with two *Firestreak* missiles under the wings.



The de Havilland *Comet 3* (four Rolls-Royce *Avon RA. 29s* with built-in sound suppressors), in B.O.A.C. colours.

Small but lively: the Miles M. 100 *Student* basic jet trainer (Turboméca *Marboré 2*).

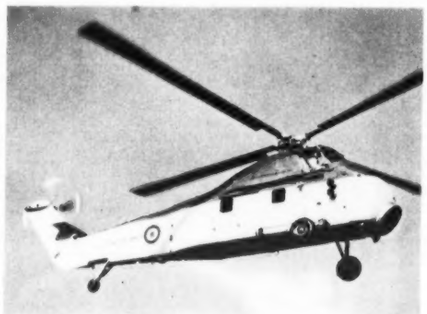
English Electric *Canberra B. 8* light bomber.

Bristol *Britannia 310* long-range commercial transport.

English Electric *Canberra* as flying test bed for a Napier *Double Scorpion* rocket engine mounted in the bomb bay.

Exceptional rate of climb and descent: the Fairey *Ultra Light* helicopter (Blackburn *Palouste*).

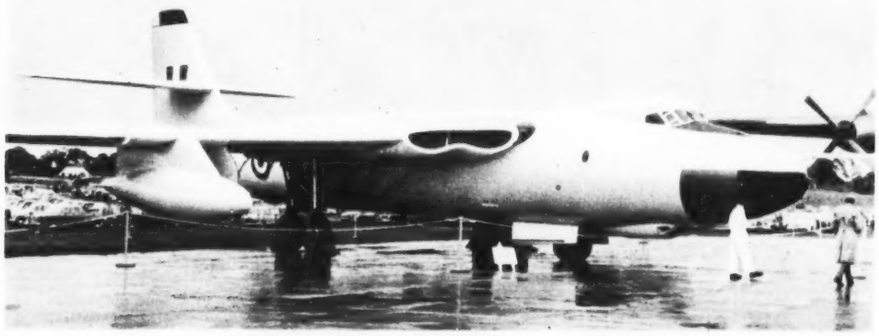
A new basic trainer for the R.A.F.: Hunting Percival *Jet Provost Mk. 3* (Armstrong Siddeley *Viper 8*).



Westland *Wessex* gas turbine helicopter for anti-submarine operations (Napier *Gazelle*).

The Folland *Gnat* lightweight fighter's come-back; the trainer version was recently ordered by the R.A.F.

The Vickers *Valiant B. 1* V-bomber with flight refuelling boom in the nose.



Miles HDM.105: *Aerovan* fuselage and Hurel-Dubois wing.

engine manufacturers will continue to find a world market for their products.

A recent B.E.A. order for six de Havilland *Comet 4 Bs* and the B.O.A.C. order for 19 *Comet 4s* drew attention to the displayed prototype *Comet 3* in B.O.A.C. colours, and equipped with four Rolls-Royce *Avon* RA 29s and integral silencing; the thrust reverser for these types was on show on the Rolls-Royce stand. With a new lease of life the *Comet* is making a strong bid for a place in international medium and long-range traffic. Bristol's exhibits included the second *Britannia 313* for delivery to El Al Israel Airlines, and stressed the point that long-range traffic with British turbo propeller aircraft is now an accepted fact.

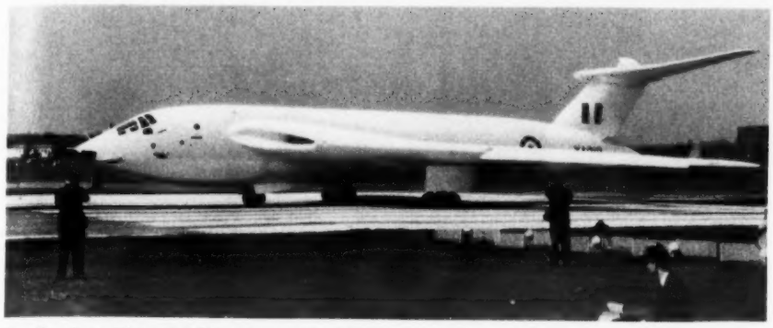
For the short-range traffic market Handley Page offered the *Herald* with four Alvis *Leonides Majors*, or at a later date, if required, with two Rolls-Royce *Darts*. Aviation Traders exhibited the *Accountant* for the first time in public and demonstrated their confidence in the future of this aircraft as a "DC-3 replacement" and executive transport. Auster also presented the new *Atlantic* 4-seat executive aircraft in mock-up form.

Was any aircraft category absent from Farnborough? Did any visitor not find the right aircraft for his particular taste?

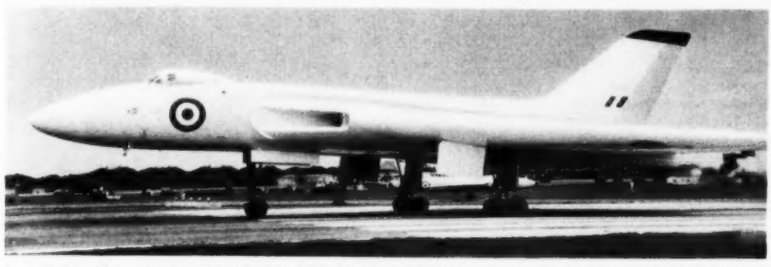
*

While the Flying Display was carried out under first class organization and clockwork precision, buyers from the four corners of the world met on the exhibition stands to settle a far less critical question—"with or without soda?"—and Farnborough remains, as before—Big Business!

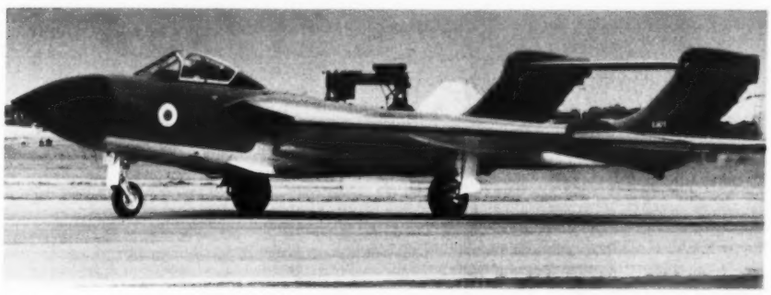
Take off... and Landing



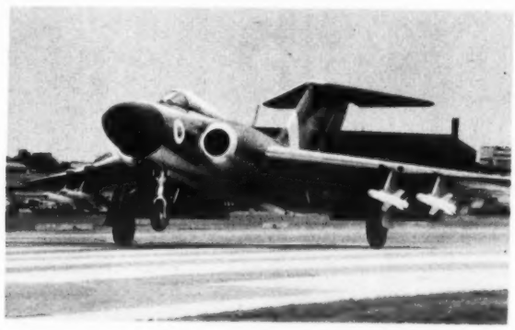
Handley Page *Victor B.1* V-bomber on 18 wheels; crescent wing with "droop snoot" outer wings and large-area landing flaps.



Avro *Vulcan* V-bomber as flying test bed for four Rolls-Royce *Conways*. Right, the standard *Vulcan B.1* bomber with Bristol *Olympus* engines and double-bent wing leading edge.

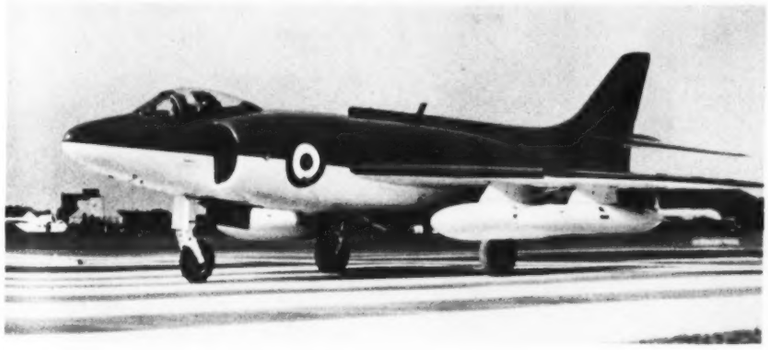


De Havilland *Sea Vixen* carrier-based all-weather fighter (two Rolls-Royce *Avons*); excellent ground visibility thanks to the offset cockpit canopy.



Gloster *Javelin FAW. 7* all-weather fighter (two Armstrong Siddeley *Sapphires*); delta wing and high-set tailplane.

Vickers Supermarine *Scimitar F.1* carrier-based supersonic fighter; "steep" landing, thanks to the droop snoot leading edge and boundary layer blowing over the landing flaps.

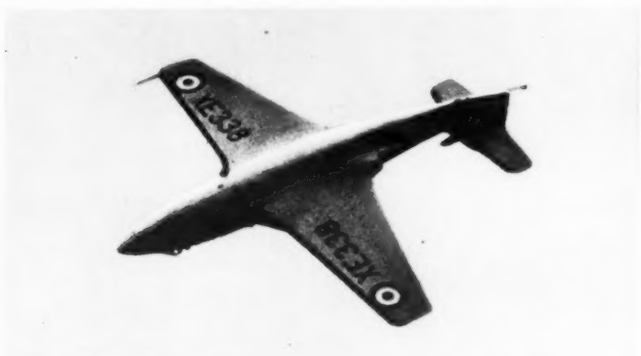


Farnborough

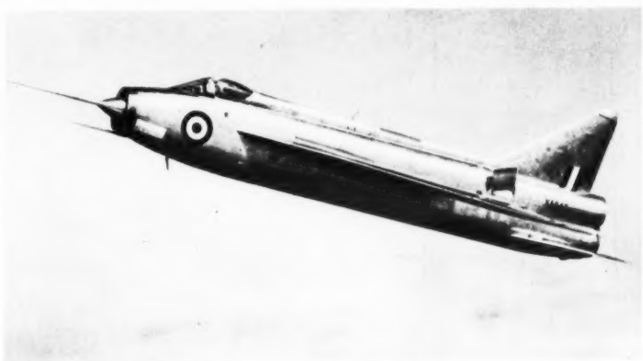
Twelve Royal Navy *Gannets* in anchor formation.

Breath-taking demonstration by a squadron of nine *Hunters:* all aerobatic figures were executed in tight formation.

New wing shape in Britain's skies: the Saunders-Roe SR. 53.



A *Sea Hawk* of 801 Squadron showing off at 150 ft.



The strongest card in the R.A.F.'s hand: the English Electric P. 1B supersonic fighter.

Five *Sea Hawks* of 738 Squadron land after their imposing aerobatic display.

Hawker *Hunter F. 4* with two *Fireflash* missiles.

◀ The English Electric P. 1A landing with brake parachute.

Recovering from the strain.

Guided Missile Sensation at Farnborough

This year, for the first time, guided weapons claimed a place of honour in the Farnborough exhibition grounds. Although the number of weapons and test vehicles shown is still small compared with the number of aircraft—a round dozen as against some 40 aircraft types—the following facts were unmistakable:

- Most of the guided weapons exhibited have reached the production stage;
- With one exception, the air-to-air weapons were also demonstrated on various aircraft during the flying display;
- Most of the models were accompanied by carefully prepared export documentation.

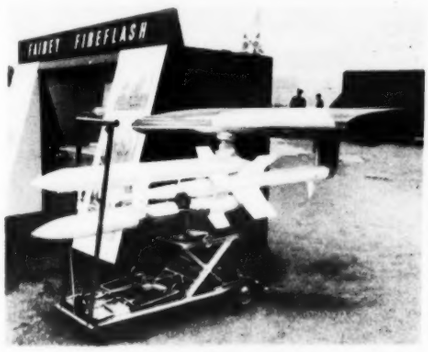
Significantly, all the responsible members of S.B.A.C. and the industry joined in the chorus of praise for guided weapons. To quote only two typical statements:

C. F. Uwins, President of the Society of British Aircraft Constructors, stated at the conclusion of the Display: "I think there is little doubt that we shall sell missiles to countries to which such sales are approved by the Government . . . The showing of these new weapons this year has been most timely; if we had not done so now foreign countries would have been encouraged to go elsewhere."

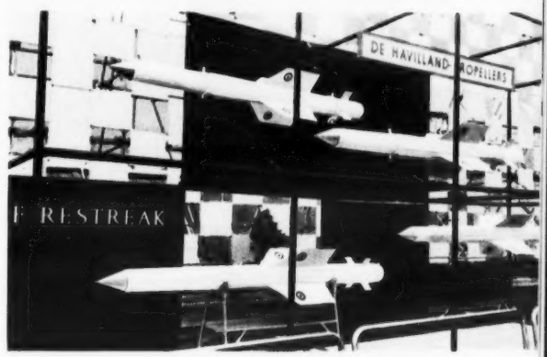
E. C. Bowyer, Director of the Society, suggested that this year's Display had set the pattern for the next few years. Guided weapons would come increasingly into the picture.

In conclusion it should be stressed that all the missiles shown are designed as complete weapons systems. Some of their basic components are discussed in the account of the equipment exhibition later in this issue.

Bristol *Bloodhound* surface-to-air weapon with semi-active radar homing head; in production for the R.A.F.



The production Fairey *Fireflash* air-to-air missile is used by the R.A.F. primarily for training purposes. There is talk of developments for operational use.



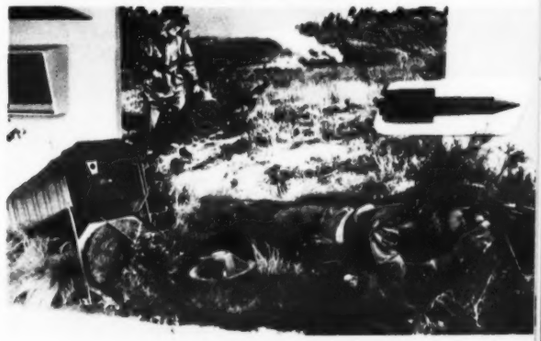
De Havilland Propellers *Firestreak* air-to-air weapon with solid-propellant rocket engine and infrared homing head. In production for R.A.F. and Navy fighters (P. 1 B, *Javelin, Sea Vixen,* SR. 53/P. 177).

Biggest air-to-air missile shown was the Vickers Type 888 (more than 13 ft. long), apparently originally developed for the thin-wing *Javelin.*

Armstrong Whitworth *Seaslug* surface-to-air missile in production for the Royal Navy; selected as standard anti-aircraft armament for the Navy.

Short's multi-purpose test vehicle for surface-to-air use (presumably against low-flying aircraft); launched with the aid of solid-propellant boosters; liquid-propellant rocket engine as prime mover.

Vickers Type 891 anti-tank rocket; can be carried into the firing line by a single infantryman and aimed by means of a periscope (bottom right in picture).



The English Electric *Thunderbird* surface-to-air missile, with semi-active homing head, can be fired from fixed or mobile launchers. Ordered for Army and R.A.F.

Farnborough

An Under-Estimated Farnborough?

Impressions of a European Military Observer

By "Miles"

For this European military observer the 1957 Farnborough Display, produced with S.B.A.C.'s usual skill, and making wide use of the R.A.F. in both leading and supporting roles, was a more brilliant spectacle than ever. Such brilliance, however, will be difficult to maintain in the years to come, in view of the new British arms policy.

On Thursday, September 5th, in particular, when the weather was friendly and the sky almost cloudless, spectators were able to watch a superb demonstration in which purely technical achievements took second place to an artistry of presentation. For the first time since the early days of the annual Display, imposing mass demonstrations hinted at Britain's air power and formed a background for the presentation of aircraft which can now be described as "classic". The object was not so much to bring out the qualities of prototypes but rather to stress the advanced stage of development of the types shown and their availability on the shelves of the great aircraft shop which Britain still represents. While *Valiants, Victors, Vulcans* and *Canberras* spun their white trails high up in the sunny blue, groups of *Hunters, Javelins* and *Gannets* revealed that they are available in quantity. Following on successive Farnboroughs reserved for the presentation of large numbers of prototypes—perhaps too many—the 1957 Display emphasized the production types and the sales of stocks of aircraft produced during recent years. But this sales show was artistically presented, and nobody will forget the triple *Hunter* patrol which traced the outlines of a three-dimensional ballet with the precision of a draughtsman.

Captious or ill-intentioned critics have not been slow to point out the "absence of new developments". Had there been a series of technical revelations, they would have been equally quick to deplore Britain's insistence on a line of development which is destined to be supplanted by the general introduction of guided missiles. In fact, Farnborough 1957 marks a turning point in our present interim period, where piloted military aircraft are losing ground to missiles, but where the latter have not yet reached the stage where they can fully replace the former.

For those who have eyes to see, Farnborough 1957 was perhaps as full of promise as Farnborough 1946. Through some unfathomable gift Britain has almost always recognized the great turning points of history. She set limits on the arbitrary power of monarchs as early as the 13th century, completed her revolution before the others, tackled and exploited the industrial era at the dawn of the 19th century, conceived the idea of a Commonwealth before the advantages of federalism had become widely accepted, and left India before it was too late. Already at the beginning of this century she was exploiting the oil resources of her overseas territories and lost no time, when the United States declared its intention of retaining its nuclear monopoly, in launching the studies and experiments which would ensure her active membership in the present "atomic club." Finally, she has been the first to grasp the political, technical and military inferences of the existence of weapons with great destructive power, publishing the famous White Paper on Defence in April this year.

Farnborough 1957 must be judged in the light of this White Paper, which also hints at the form which future Displays may take.

In the missile field, British manufacturers have suddenly revealed that they have advanced from the experimental to the production stage, becoming a strong third behind the U.S.S.R. and the United States. The A.B.C. agreements (America-Britain-Canada) have been of powerful assistance. It is not difficult to recognize in the British designs traces of Boeing, Douglas or North American developments and the vast sums of money devoted across the Atlantic to the development of missile engineering. The display of some ten different missiles is as unspectacular as a tour of an armoury, and the uninitiated can scarcely be thrilled by the sight of these tubes with conical noses, whose complicated mechanisms, about as fascinating to look at as the diagram of a radio set, are carefully hidden inside their metal skins. But apart from the United States and the Soviet Union, what country but Britain can pride itself that it has surface-to-air and air-to-air missiles (defensive) in production, and is completing prototypes—probably under licence—of surface-to-surface and air-to-surface (offensive) missiles? Though perhaps outpaced by the "Biggest Two," Britain is several lengths ahead of the rest of Europe.

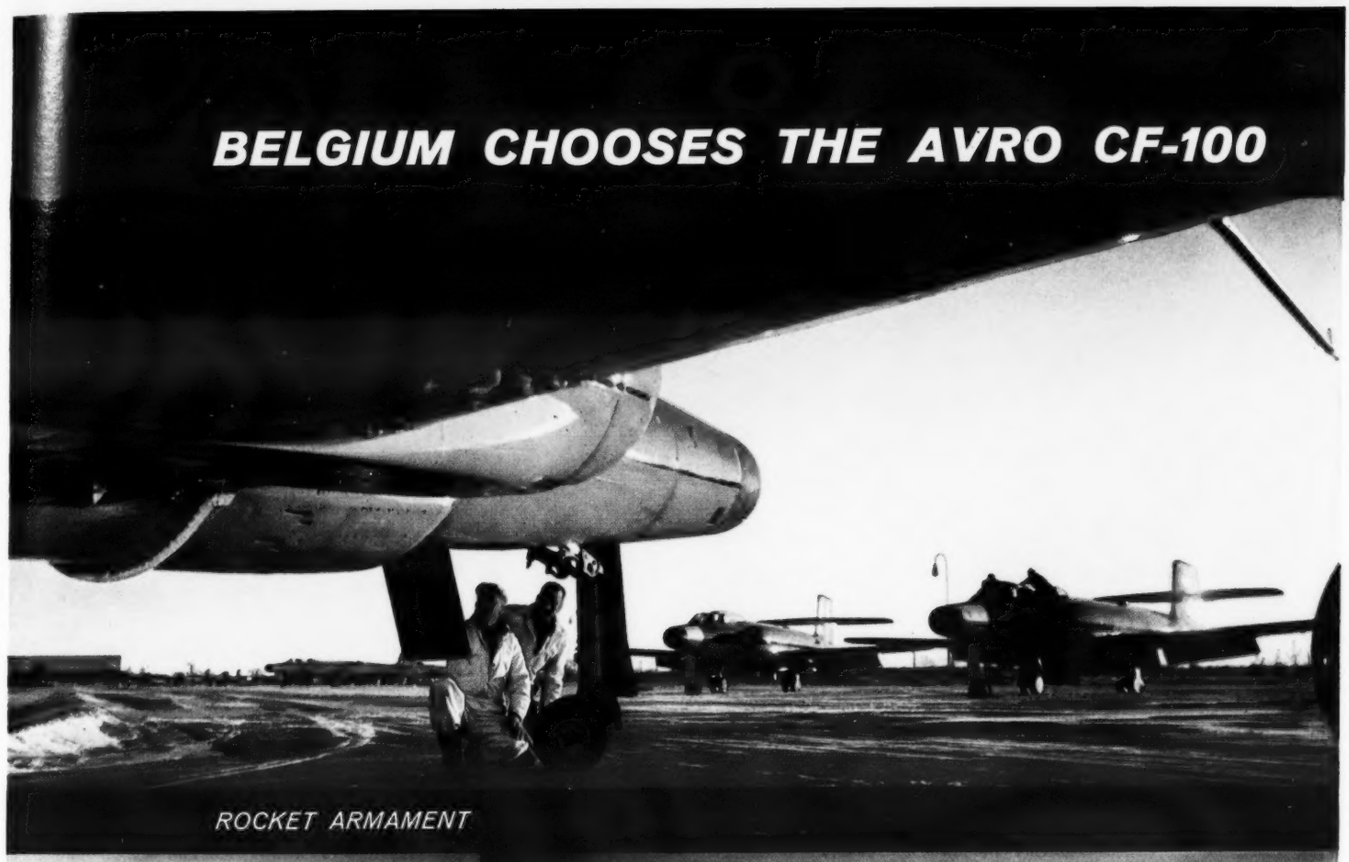
In the field of equipment for the transition period, the English Electric P.1B for combined defence and offence, and two of the V-bombers for offence can be as valuable to Britain as the Boeing B-52 and Republic F-105 to America, making allowance for the difference in strategy which geography imposes on the two countries. These aircraft have been built, or will be built, only in small numbers? Is this a valid criticism when every schoolboy knows that a single thermo-nuclear projectile can cause damage far in excess of that inflicted by 4,000 or 5,000 of yesterday's bombers using TNT bombs? These aircraft may well be vulnerable to surface-to-air missiles, such as the *Talos* or the *Bloodhound*, or the Russians' automatic missiles, but does not the same apply to the Boeing B-52, the *Badgers* or *Bisons* and even the Convair B-58? What difference do a few extra hundredths or even tenths of a Mach number make in the face of a missile flying at 100,000 ft. and speeds of 2,000 to 3,000 knots? For the deterrent to be effective, it is enough that the adversary should have a healthy respect for even a small number of nuclear weapons. This is the basic argument in the White Paper, and in a certain measure Britain possesses the instruments for such a defence policy. Whether this defence policy will still permit her to play an international role is another question, but at any rate she does have the means of dissuading any potential enemy from attacking her vital resources and wiping her off the map as a great free power. The absence of "novelties" may be deplored, but there is one fact that should not be underestimated, namely that Britain is the only country in Western Europe which can exploit the nuclear deterrent and thus, having ensured her own protection, can tackle the difficult problems of tomorrow's world.

The imposing presentation of this last Farnborough Display underlined the show's commercial side. The main accent was obviously placed on the *Hunter*. Its long adolescent troubles have at last been overcome and, although it will soon be disappearing from the skies of Britain along with some of the Fighter Command squadrons now using it, it will still have a basic role to play in the armouries of the smaller powers. Tomorrow the *Javelin* may meet the same fate, while the Fairey *Gannet* will continue to demonstrate the advantages of piloted aircraft on tasks for which robots will long continue to be unsuitable. Finally, if it became necessary to back up the defensive missile, use could be made of mixed jet-cum-rocket propulsion for interception at very high altitudes (Saunders-Roe SR.53).

There remains the world market for civil aircraft, from which British manufacturers are by no means prepared to withdraw. The quality and variety of the power units at their disposal give them every reason to hope for success, provided some of the funds saved on piloted combat aircraft are allocated to civil prototypes, rather than all going on missiles. The Avro *Vulcan* with by-pass *Conway* jets, which silently paraded its great wing unit in front of the S.B.A.C. President's tent, showed that R.A.F. Bomber Command is also the flying test bed for tomorrow's commercial engines. With the *Conway*, the *Olympus*, the *Proteus* and the *Orion*, the *Tyne* and the *Eland* at their disposal, British designers can choose the powerplants best suited for long and medium range commercial transports. The Napier *Gazelle* gas turbine, the Rolls-Royce *Dart RDa.7* propeller turbine and the Bristol *Orpheus* jet are capable of powering the smaller transports now being designed and built in all aircraft manufacturing countries. If it is found that development of the ballistic missile is too slow, or if its accuracy is unsatisfactory because of shortcomings in the guidance system, British manufacturers will always be able to produce a manned bomber for speeds of more than Mach 2, powered by two *Iroquois* jets, whose thrust does not appear to have been equalled elsewhere. The corresponding aircraft could be developed and built quickly, since the essential elements—powerplant, navigation and bombing equipment—are already in existence. The far-sighted policy which the British industry has followed in the engine field gives it good prospects of success in its efforts to extend its civil markets—despite the lead which the Americans have gained with the Boeing and Douglas jets. The *Britannia* may have the same success as the *Viscount*, followed by the *Vanguard*. If the Armstrong Whitworth AW.650 sells as well as the Bristol 170, the Hawker-Siddeley Group will not have risked in vain the money it is spending on 10 pre-production aircraft. And if the V.C.10's characteristics have been wisely chosen, the market for long range transports can be tackled, with the aid of the quality of its powerplants. What other aircraft industry could say as much when it comes to disputing the United States' present monopoly in commercial aircraft? Is it therefore correct, or even wise, to talk about a "disappointing Display"? There have been earlier Farnboroughs which were more disappointing, because certain of the developments presented were in sectors which were obviously condemned to disappear. "Novelty" is not an end in itself, even though it may have its attractions for the layman.

The recent official statement of defence policy by the London Government may have its advantages, even as regards research and production. The cuts in funds allocated to design offices will reduce "surplus fat" and necessitate a concentration of efforts on a small number of carefully chosen development lines. Such is at any rate the compensation which their friends sincerely wish for Britain's designers, in their present concern at the somewhat abrupt change of direction decreed by Mr. Duncan Sandys.

BELGIUM CHOOSES THE AVRO CF-100



ROCKET ARMAMENT

ELECTRONIC FIRE CONTROL

ALL-WEATHER OPERATION

SUPERIOR QUALITY RE-CONFIRMED

The announcement that Belgium will augment its Air Force with Avro CF-100 interceptors is received in Canada with pride and gratification.

The CF-100 was designed to meet R.C.A.F. specifications for a long-range, day or night, all-weather interceptor, with automatic fire control, for the defence of Canada.

The decision of Belgium to add these interceptors to its air strength is seen as further confirmation of the superior quality of the aircraft.

HIGH ALTITUDE

AVRO AIRCRAFT LIMITED

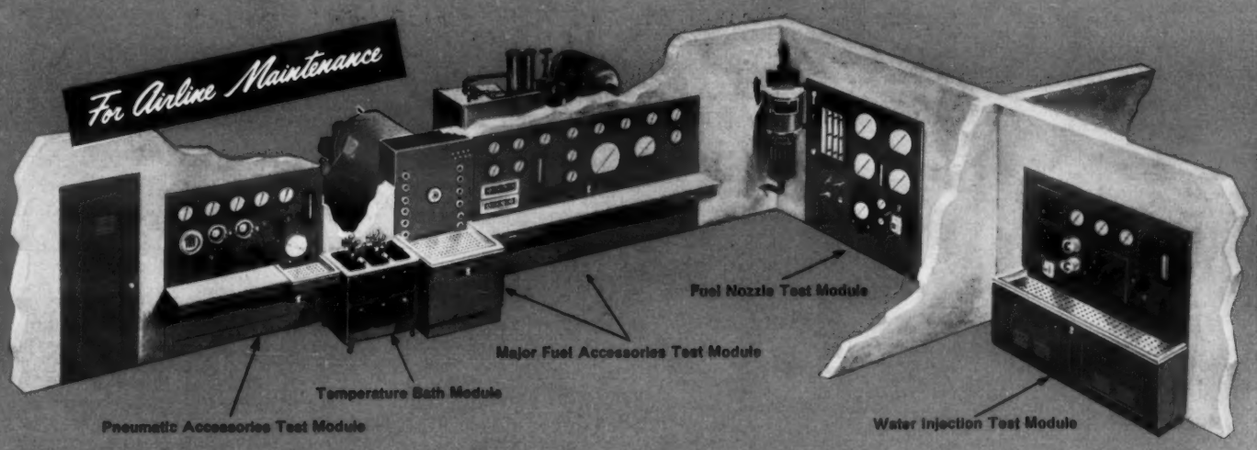
AVRO AIRCRAFT

MALTON, CANADA

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

THE GREER JET ENGINE ACCESSORIES TEST FACILITY

Practical in Operation · Economical to Purchase · Geared for Expanding Work Loads



The Greer Test Facility meets immediate requirements for jet airliner maintenance...Keeps capital expenditure to an absolute minimum...Test modules can be added as work load increases...Facility provides experience for future test equipment purchases...For complete engineering details and specifications, write to Greer for illustrated brochure today.

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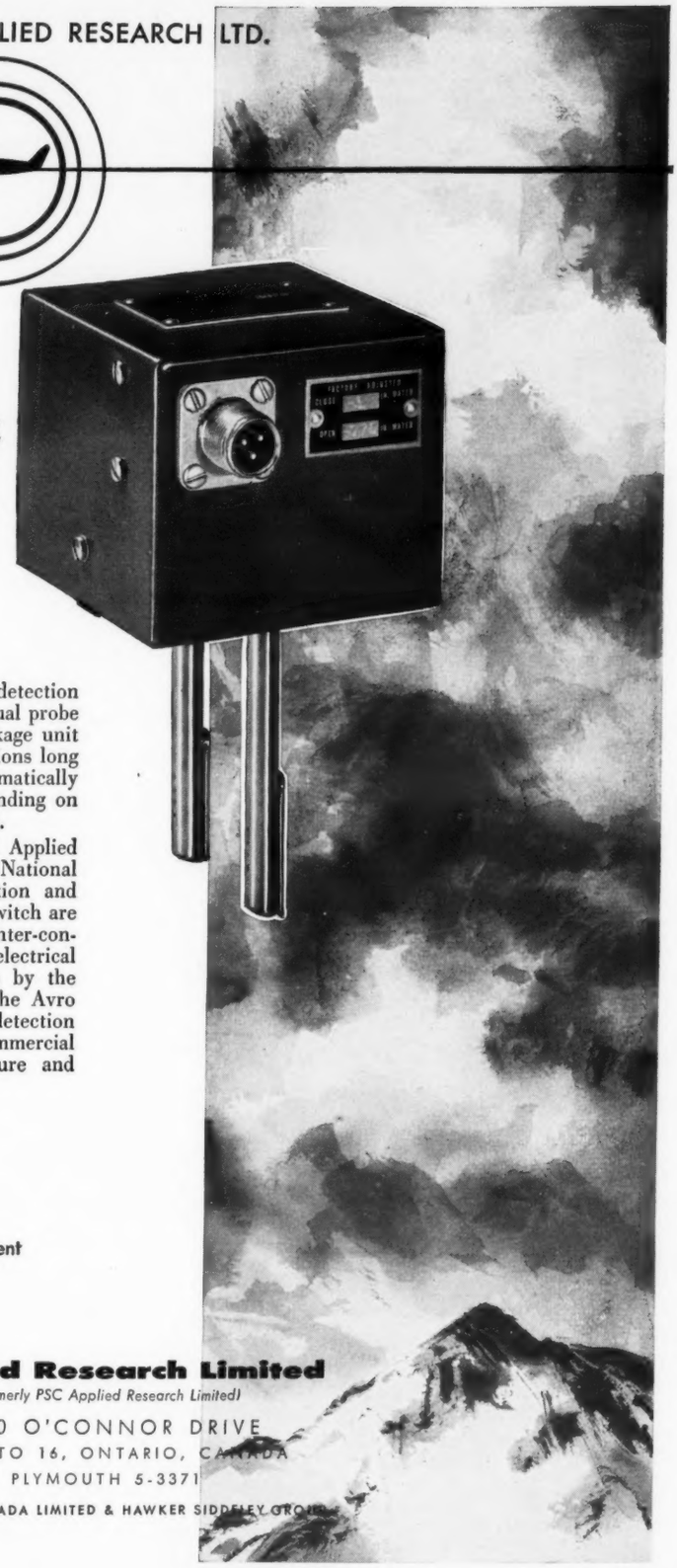
ANOTHER FIRST BY PSC APPLIED RESEARCH LTD.



The World's most efficient Ice Detection System . . .

You are looking at the most efficient ice detection system yet developed — the Type T260 dual probe detector. Here is a 1¾-pound, sealed package unit that either warns the pilot of icing conditions long before he can see ice forming, or automatically controls his ice shedding system — depending on the application of the 28 volt output pulse.

Engineered and manufactured by PSC Applied Research Limited, under license from the National Research Council of Canada, the detection and reference probes and associated pressure switch are contained in a sealed unit, eliminating inter-connecting pneumatic tubing and reducing electrical cable requirements. Operationally proven by the RCAF and now standard equipment on the Avro CF-100 and its Orenda jet engines, the ice detection system is now available to private and commercial aircraft operators. Write us for literature and quotations.

Specifications:

Size — 3⅛" x 3⅛" x 5²¹⁄₃₂"
Probes — 3" long, 5⁄16" diameter
Weight — 1¾ pounds
Power — 28 volts, 15 amps. intermittent

Canadian Applied Research Limited

(formerly PSC Applied Research Limited)

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MEMBER: A. V. ROE CANADA LIMITED & HAWKER SIDDELEY GROUP

Royal Swedish Navy Orders Vertol 44's

A special committee of the Swedish Navy made a year-long study of helicopters suitable for anti-submarine warfare as well as utility transportation. In the United States they consulted with headquarters personnel of the three armed services, visited helicopter manufacturers and toured military operating units.

At the conclusion of this intensive study, the Swedish Navy placed an initial order for four of the 22-place Vertol 44's, to be augmented later by additional procurement.

Official Navy announcement of the purchase said the choice was mainly based upon the Vertol 44's "good stability in hovering and towing missions, good instrument flight capabilities and mission endurance . . . practically unlimited controllability for the contemplated missions."

Sweden thus became the fifth western nation to purchase the sturdy Work Horse helicopter, first choice of the experts for the most difficult assignments.

In commercial or military use the Vertol 44 offers these features:

- Highest useful load, largest seating capacity
- Lowest seat mile cost
- Automatic stabilization
- Instrument flight capability

For detailed information write: Customer Relations Manager

VERTOL Aircraft Corporation

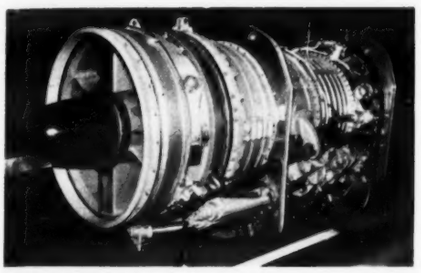
MORTON, PENNSYLVANIA

First Impressions of the Equipment Exhibition

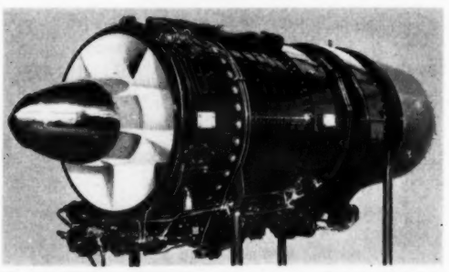
It is difficult to recall any earlier S.B.A.C. Show which presented such a wide selection of engines and equipment as was seen in 1957. A tour of the huge Exhibition Tent at Farnborough confirmed the impression which had been given by the British manufacturers' stands at this year's Paris Show, that the equipment industry has been promoted to the key position in British aviation. Over 300 firms presented an overall picture of an incredibly varied production programme, which not only forms the cornerstone for modern aircraft construction, but at the same time points the way for future British developments.

Especially noteworthy is the degree to which the equipment manufacturers have met the demands of the guided missile designers, necessitating in some cases radical changes in the whole structure of the industry. In the circumstances it is not surprising that Britain's Minister of Supply quite recently felt called upon to state that the electronics industry now plays a more important part in the development of missiles than the aircraft industry. In view of the importance of the subject, the new developments in the field of British electronics are covered in a separate article in this issue.

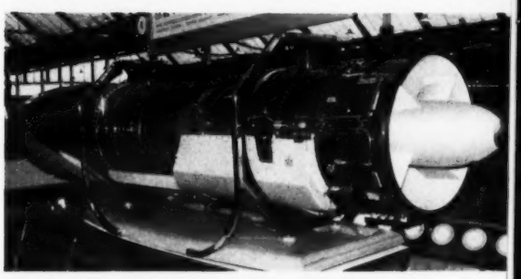
Engines



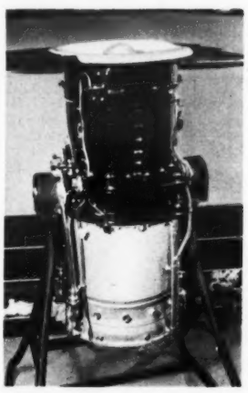
Bristol Aero-Engines Ltd.: The *Olympus BOl.6* double compressor turbojet has 16,000 lbs. thrust and is now in production for the Avro *Vulcan B.2* in the V-bomber class.



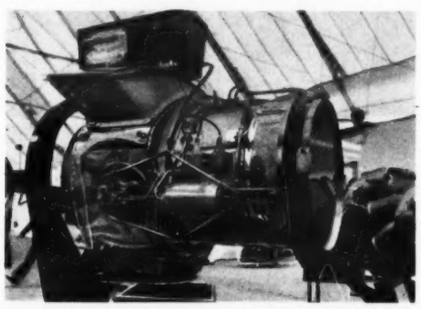
The de Havilland Engine Co. Ltd.: Designed for supersonic aircraft, the *Gyron Junior DGJ.1* single-spool turbojet engine has a six-stage compressor, annular combustion chamber with 13 burners and a multi-stage turbine: provisional static thrust 8,000 lbs.



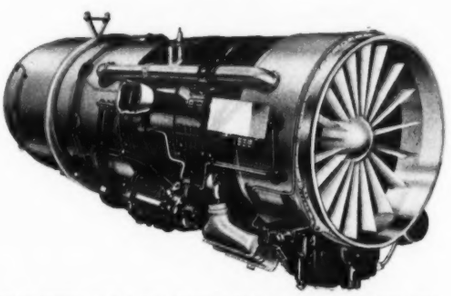
Orenda Engines Ltd. (Hawker Siddeley Group): The *Iroquois* double compressor turbojet with approximately 20,000 lbs. static thrust. This was the engine's first appearance in Europe; it is destined for the Avro CF-105 *Arrow 2* supersonic fighter.



Rolls-Royce Ltd.: The RB.108 lightweight turbojet engine has been developed from the *Soar* and is reported to have a very high power-weight ratio; it will be used in the Short SC.1 experimental VTOL aircraft.

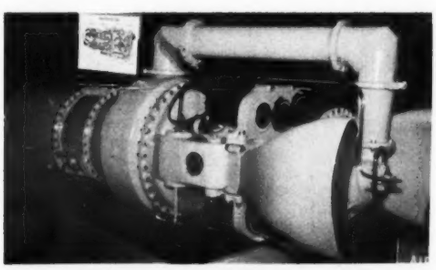


Rolls-Royce Ltd.: A thrust reverser for the *Avon* turbojet engines to be fitted in the de Havilland *Comet 4*. Similar reversers are to be supplied for the *Conway* engines in the Boeing 707.

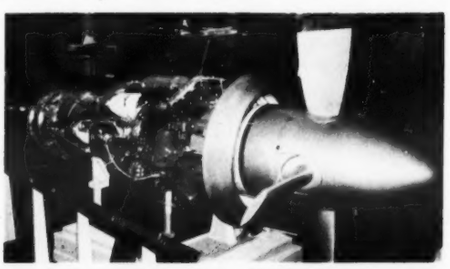


Rolls-Royce Ltd.: The *Conway RCo. 10* bypass turbojet with a static thrust of 16,500 lbs. will be fitted to some of the Boeing 707s and Douglas DC-8s already ordered, as well as the 35 Vickers-10s on order for B.O.A.C.; a more powerful version is planned for the Handley Page *Victor B.2* bomber.

Bristol Aero-Engines Ltd.: The *Orion BOn.2* turboprop of 5,150 e.h.p. is destined for the Canadair CL-44 and later versions of the *Britannia*.

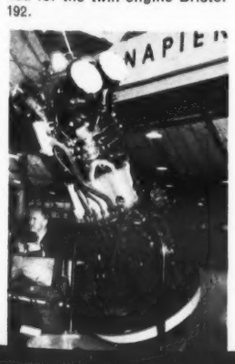


Blackburn & General Aircraft Ltd., Engine Division: The *Palouste* turbo gas generator is produced in different versions for use as an air compressor for starters and rotor tip nozzles e.g., in the Fairey *Ultra Light helicopter*.

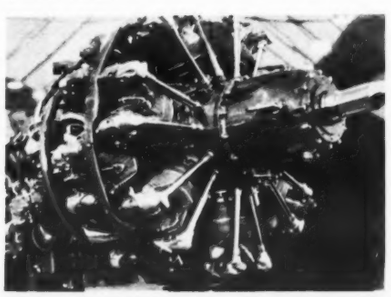


D. Napier & Son Ltd.: The Eland NEl.6 turboprop of 3,500 e.h.p. will be fitted to the Convair Liners on order by several leading airlines; the NEl.3 derated helicopter version will be used in the Fairey *Rotodyne*.

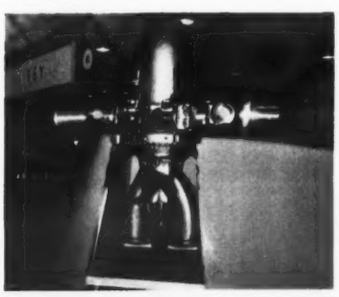
D. Napier & Son Ltd.: The *Gazelle NGa.13* helicopter gas turbine with 1,800 h.p. shaft power is used in the Westland *Wessex*; the type NGa.2 is planned for the twin-engine Bristol 192.



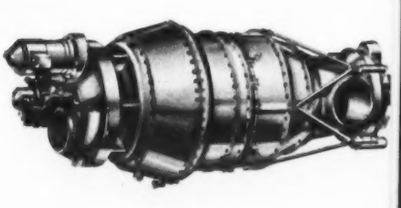
Alvis Ltd.: The *Leonides Major* 14-cylinder two-row radial engine of 875 h.p. take-off rating powers the Handley Page *Herald*.



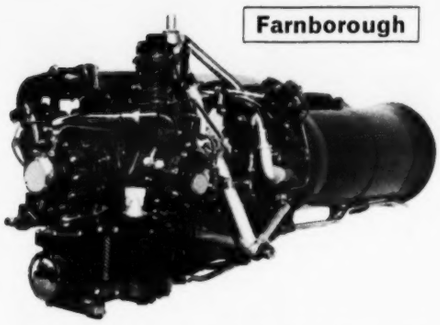
Fairey Aviation Co. Ltd.: The rotor head of the Fairey *Rotodyne* helicopter, with compressed air ducts.



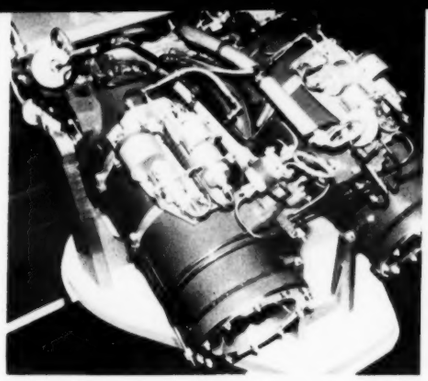
Armstrong Siddeley Motors Ltd.: Seen for the first time at Farnborough was the P. 181 free turbine helicopter engine. Shaft power 1,000 h.p.; specific fuel consumption 0.685 lbs./e.h.p./hr.



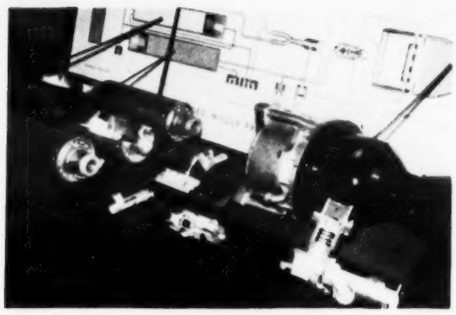
Farnborough



The de Havilland Engine Co. Ltd.: The *Spectre* liquid-propellant rocket engine uses kerosene and hydrogen peroxide. The thrust of this unit, installed in the *Saro SR.53*, is reported to be in the range of 8,000 lbs.



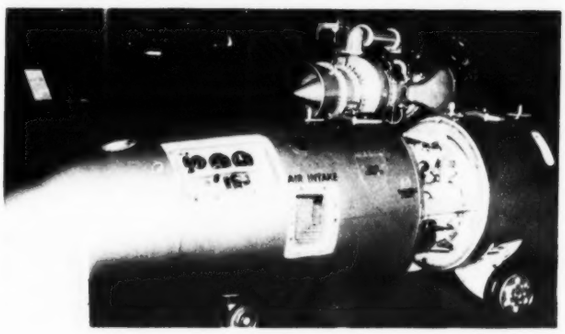
D. Napier & Son Ltd.: The *Double Scorpion* liquid-propellant rocket engine with two independently controllable combustion chambers, also uses kerosene and hydrogen peroxide; total thrust 8,000 lbs.



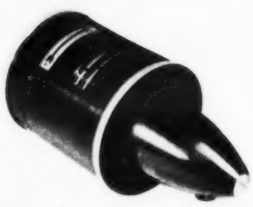
Short Brothers & Harland Ltd.: Liquid-propellant rocket motor for a new Short surface-to-air experimental weapon. This engine also runs on kerosene and hydrogen peroxide, fed into the combustion chamber by compressed nitrogen.

Engine and Airframe Accessories

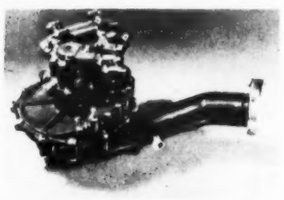
D. Napier & Son Ltd., London: Cut away model of the streamlined main body of a ramjet engine. The nose (shown here pointing upwards) faces the inlet, and mounted on the tail below are eight arms carrying the fuel injection nozzles. The main body houses not only the fuel tanks and control system, but also meters and guidance equipment.



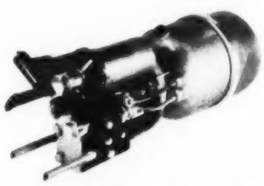
Blackburn & General Aircraft Ltd., Engine Division, Brough (East Yorks): Mobile low pressure air starter for jet engines. The unit incorporates a *Palouste 500* gas turbine and is completely self-contained, streamlined, with retractable tricycle undercarriage and is transportable on aircraft external store pylons. Weight approximately 970 lbs.



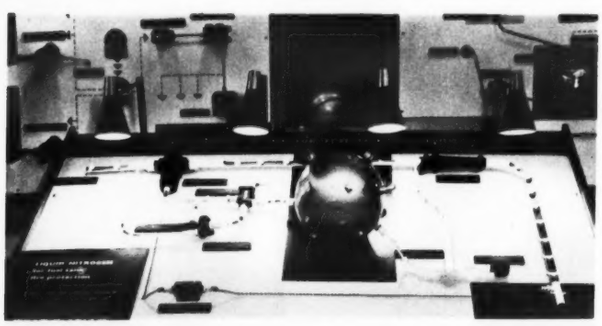
Plannair Ltd., Leatherhead (Surrey): High efficiency axial flow blower Type 3PL181-198 for boosting air flow from an air conditioning system or for extracting fumes from batteries or cooling inverters. 28 volt DC motor; at 11,000 r.p.m. volumetric air flow is 80 cu. ft. per minute.



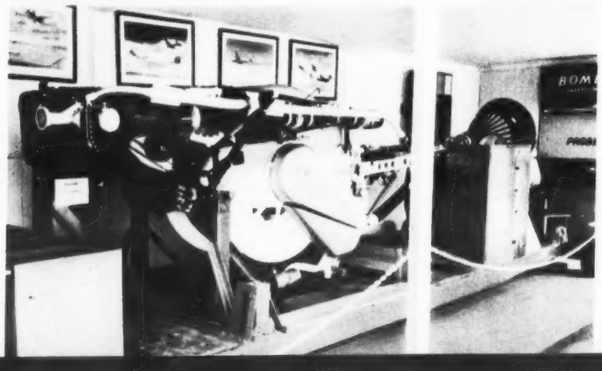
The de Havilland Engine Company Ltd., Leavesden (Herts): Auxiliary power unit with hydrogen peroxide/steam driven low-loss turbine provides an additional or emergency source of power for all types of airborne equipment. This auxiliary unit is capable of producing 25 b.h.p. at any altitude and is particularly favourable for installation in high altitude aircraft and guided weapons.



Plessey Company Limited, Ilford (Essex): The guided weapon hydraulic power pack has been developed for recharging servo-hydraulic accumulators. The turbine-driven unit, using Iso Propyl Nitrate Monofuel, drives a hydraulic pump which provides a varied fuel flow to the combustion chamber. 20 hydraulic h.p. at pressures up to 4,500 p.s.i.; dry weight 16 lbs.



British Oxygen Engineering Ltd., Aircraft Section, Harlow (Essex): Liquid nitrogen system for fire protection of fuel tanks. Liquid nitrogen is fed from the container (seen in the centre of the picture) to a swirl atomizer located within a section of the supply ducting to the fuel tank; here it vaporizes and mixes with air from the engine compressor passing to the fuel tanks. The oxygen content of the mixture is controlled from the temperature as it enters the fuel tank by means of a ductstat control operating a valve in the air line.



Flight Refuelling Ltd., Blandford (Dorset): Complete equipment for conversion of a V-bomber into a refuelling tanker. The picture shows an installation comprising a Mk. 16 Hose Drum Unit Package Unit with supply pump (on left of picture) and a refuelling hose with funnel. The transport vehicle for the fuelling system contains all tools and test equipment for the installation of the equipment at advanced airfields so that rapid conversion of any V-bomber into a tanker is possible.

From the Exhibitors' Catalogue

Aero Research, Duxford, (Cambridgeshire): Araldite epoxy resins for glasscloth laminates, surface coatings, electrical insulation, etc. Redlix and Hidux adhesives for load bearing metal structures. Lightweight honeycomb cores.

Avery-Hardoll Ltd., Chessington (Surrey): Aviation replenishing equipment for fuels, oils, methanol-water and other liquids and gases; airfield hydrant pits, bulkmeters, dispensers, etc.

Bristol Aero-Engines Ltd., Filton (Bristol): Rocket tubes, pressure vessels, drop-tanks, radar scanner, void-free radome shell.

English Steel Corporation Ltd., Sheffield and Manchester: Three subsidiary companies showed special steel drop-forged components for airframes, engines and landing gear; airframe components, gas-cut from alloy steel plate; cutting tools, etc.

Fairey Aviation Co. Ltd., Hayes (Middlesex): Hydro-booster powered flying controls.

P. Frankenstein & Sons (Manchester) Ltd.: Protective and survival equipment, life jackets and life rafts, etc.

Girling Ltd., Tyseley (Birmingham): Disc brakes, hydraulic dampers for aircraft controls and control surfaces.

Josef Lucas Batteries Ltd., Birmingham: A range of aircraft and ground installation batteries.

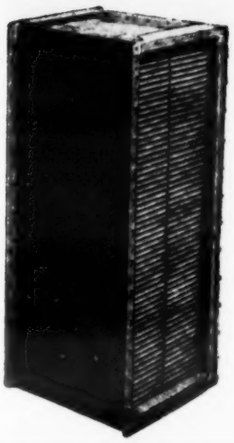
Normalair Ltd., Yeovil (Somerset) and the associated Australian and Canadian companies demonstrated a complete system for air conditioning, pressurization and oxygen equipment for a large supersonic transport aircraft; also sectioned models of refrigeration turbines, air compressors and various oxygen equipment.

R.F.D. Company Ltd., Godalming (Surrey): Rescue and survival equipment; model of a triple booster for guided weapons; air gunnery training equipment.

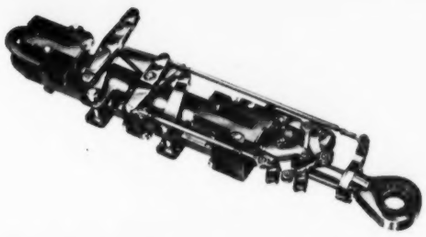
W. Bryan Savage Ltd., London: Amplifiers, vibration testing equipment, moving coil vibrator with electro-magnetic transducer for a frequency range of 5 to 5,000 cycles; rate-of-turn tables for the testing of rate gyroscopes; DC mains equipment.

Williamson Manufacturing Co. Ltd., London: F.96 high altitude reconnaissance camera; UAC multi-purpose hand camera; Eagle 10 survey camera, etc.

Graviner Manufacturing Co. Ltd., Slough (Bucks): Firewire-Jet Alight Indicator. This device is in the form of a probe which is introduced into a jet engine combustion chamber to record lightup or flame-out conditions remotely; it is particularly suitable for helicopter tip jets where accelerations of up to 1,000 g exist.

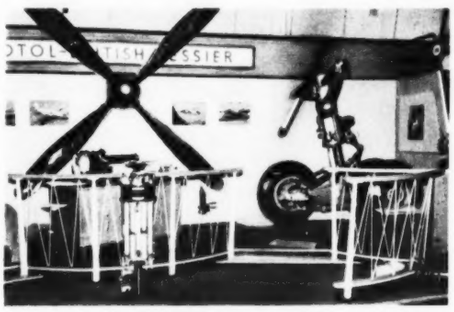


Delaney Gallay Ltd. London: Heat exchangers in stainless steel or aluminium alloy are produced for a wide variety of civil and military aircraft. The element pictured here is for the de-icing equipment on the Vickers *Viscount*. In addition to lightweight coolers of all types Delaney Gallay also produces Thermoflex high temperature insulation for jet pipes.



Boulton Paul Aircraft Ltd., Wolverhampton: Hydraulic tandem ram with two rotary valves for elevon operation; hydraulic supply is provided by duplicated engine-driven pumps so that in the event of failure of one system the unit will continue to function, but at half load; the unit can be operated manually or adapted for electrical operation by a torque motor; electrical operation permits the introduction of autopilots, autostabilizers, variable gearing, etc. into the aircraft control system.

General Airborne and Escape Equipment

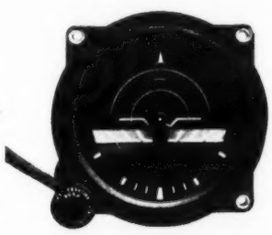


Rotol Ltd. — British Messier Ltd., Gloucester: A joint exhibition by these two companies featured a propeller for the *Dart* turboprops in the Fokker *Friendship*, ram-air turbines, fuel flow meters and cutaway models of the Bristol *Britannia* and Folland *Gnat* landing gear.

Sperry Gyroscope Co. Ltd., Brentford (Middlesex): Alongside gyroscopes, autopilots, integrated control and instrumentation systems, etc. Sperry presented pumps, valves, powered controls and the complete guidance system for an undesignated guided missile with controls for cruciform guide vanes (on right of picture).

Dunlop Rubber Co. Ltd., Aviation Division, Coventry: Pressure reduction valves, filters, air dryers and compressors for pressures up to 3,000 p.s.i., in addition to tyres and braking accessories produced by this company. The air compressor seen in the centre of the picture has been tested up to a pressure of 4,000 p.s.i.

Martin-Baker Aircraft Co. Ltd., Higher Denham (Middlesex): The Martin-Baker Mk. 5 fully automatic ejection seat is at present undergoing tests in the U.S.A. on a rocket sled and is planned for installation in the Grumman *Cougar* jet trainer.



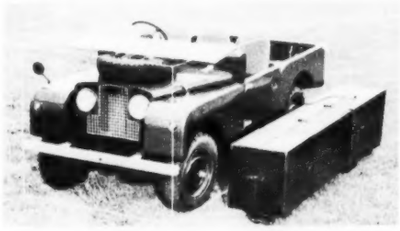
Ferranti Ltd., Aircraft Equipment Department, Manchester: The Type F.H.9 artificial horizon provides visual indication of pitch and roll under all flying and climatic conditions; full requirements for daylight, ultraviolet and red lighting are met by the two-colour bar.

Kelvin & Hughes (Aviation) Ltd., Basingstoke (Hants): In association with the Ministry of Supply, this firm has developed an integrated flight data system which, by the use of a computer, integrates the flight dynamic and aerodynamic information on a comprehensive display; flight director command information is also displayed, using a moving graphical index.

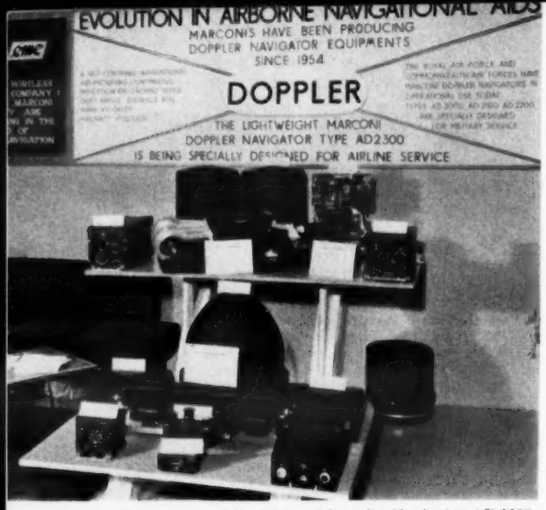
Ground Equipment

Heenan & Froude Ltd., Worcester: This company showed a prototype of the new I.E. load absorbing dynamometer for use where high accuracy of torque measurement is not required; the equipment comprises a water brake with variable output flow and a hydrostatic capsule weighing system. The dynamometer can be driven from either end.

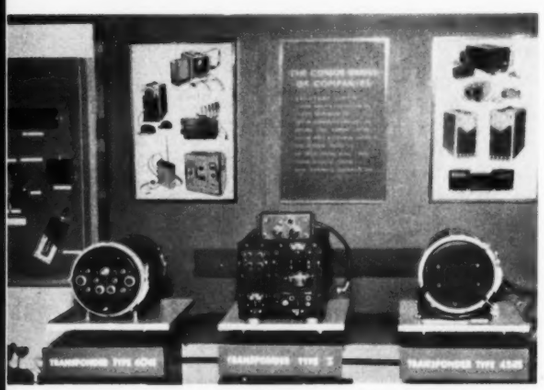
Hunting Percival Aircraft Ltd., Luton Airport (Beds.): The company has developed a lightweight folding motor vehicle for airborne operations which, powered by a 2-cylinder B.S.A. 0.6 litre engine, can carry four men in full battle order. Christened the *Harrier*, this vehicle weighs 700 lbs. and when folded occupies only 33 cubic feet of hold space. Pictured above is the folded *Harrier* alongside a standard British Army jeep.



Pyrene Co. Ltd., London: Firefighting trucks for airfields, fire extinguishers for airborne and ground use as well as fire warning systems were shown by this company.



Components of the Marconi Doppler Navigator AD2300. This system which has been in service with the R.A.F. for three years, has now been redesigned for civil operation.



Cossor also showed the latest forms of secondary radar airborne transponders. Left and right: Type 6061 and Type 4585 for military use. Centre: the Type 3 for civil use.

Farnborough

Avionics at Farnborough*

This year's S.B.A.C. Display at Farnborough has underlined the ever increasing importance of the electronic industry to aviation, in both the military and civil fields. Almost every present-day aircraft or guided missile relies on electronics for its operational efficiency; aircraft are enabled to fly safely along the crowded air routes of the world, and guided missiles are utterly dependent on a network of electronics ranging from initial detection of the enemy to the physical control of the defence missile itself.

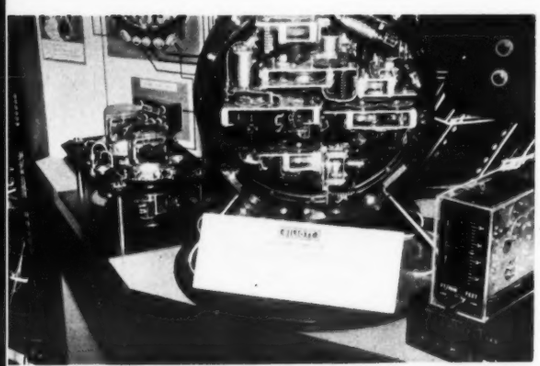
Electronic engineering is called upon to keep one step ahead of advancing technology in the aviation industry with each increase in the range, speed and height of aircraft. The aircraft industry is dependent on electronics not only for the guidance, control and navigation of aircraft, but also to an increasing extent in the design, manufacturing and testing processes. Electronic computers, for instance, enable considerable time and money to be saved in the early stages of a new project by making possible the theoretical flight testing of aircraft without the necessity for building models or prototypes. Electronic equipment is also widely used in general industrial research, production and testing processes, e.g., the Ferranti *Pegasus, Mercury,* the Short computer, the English Electric *Deuce* and G.E.C. *Stardac,* etc.

Although many of the firms engaged in electronic work were prevented by security restrictions from displaying some of their most advanced achievements at Farnborough, it was clear that the present trend is towards equipment to cope with increasingly complex tasks with a parallel reduction in size and weight. The 1957 apparatus is more robust and capable of standing up to the great forces of acceleration of rocket engines, and components have been developed to operate reliably at temperatures which were earlier considered impossible. To work at 150°C is now commonplace.

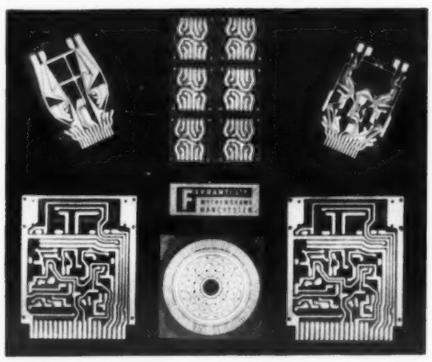
*

Much of the equipment to be seen was connected with the design, testing and operation of control systems for guided missiles. Ferranti Ltd., who designed and built the guidance and control system for the *Bloodhound* surface-to-air weapon, showed some of the radar and electronic components. The Sperry Gyroscope Co. Ltd. exhibited guided weapon control systems and showed the electronic unit of a missile with the covers removed; stress was laid on the precision techniques involved. The *Firestreak* air-to-air missile was shown by de Havilland

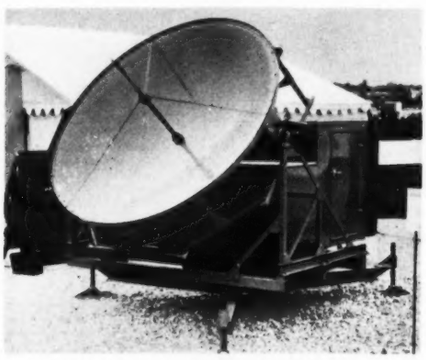
* See also page 1060 of this issue: British Ground Aeradio and Communications Equipment, and Ground Radio and Radar Aids to Navigation.



The Elliott Bros. Air Data Computer which provides automatic and almost instantaneous coordination of a number of factors affecting the flight of an aircraft.



Ferranti showed Printed Circuits which are used in their guidance and controls systems for the *Bloodhound*.

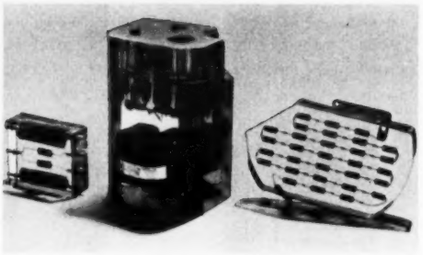


The Decca Windfinding Radar equipment operates in the 3-cm band with a peak power of 20 kW. The 2.5 m dish aerial gives a beam of 1° width which is spun to describe a 1° diameter cone; directional information is thereby obtained within a cone of 2° diameter.

Personality Parade

1 — Admiral Lord Mountbatten, First Sea Lord and Chief of Naval Staff, in conversation with a gentleman from the F
2 — Admiral Sir Matthew Slattery (right), Chairman and Managing Director of Short Brothers & Harland, talkin
R. E. Harvey, Director and General Manager. **3** — E. L. Beverley (second from left), Sales Manager, English Electric Gu
Weapons Division, discusses the *Thunderbird* missile with a South American delegation. **4** — Sir Conrad Collier, Chief E
cutive, English Electric Guided Weapons Division.

Shorts' Research Department has developed a Low Frequency Decade Oscillator for low frequency servo testing. Frequency range 0.01-100 cps with maximum output voltage of 20 V peak.



Denis Ferranti Meters Ltd. showed electronic components cast in plastic.

Propellers Ltd.; guidance is achieved by means of an exceptionally sensitive infra-red photo-cell which detects the heat radiated from the target; the Mullard Ltd. infra-red cell, developed for this purpose, can detect the heat of an ordinary domestic fire at a distance of several miles.

In the control of guided missiles, electronic computers—either miniaturized and carried by the weapon itself, or larger equipment at the ground control station—are essential to combine all the required information at the speed necessary to direct the weapons to their targets. Both in the missile and the modern aircraft the quantity of data constantly produced by various devices and controls has become so great that it can no longer be assimilated sufficiently rapidly by the humain brain. Elliott Brothers (London) Ltd. and Kelvin & Hughes (Aviation) Ltd. showed forms of air data computers which automatically and almost instantaneously coordinate a number of factors affecting flight. The General Electric Co. Ltd. showed an experimental missile guidance receiver which demonstrated how transistors, printed circuits and the block casting of sub-assemblies in plastic resin can result in an equipment which although complex is extremely small, light and efficient.

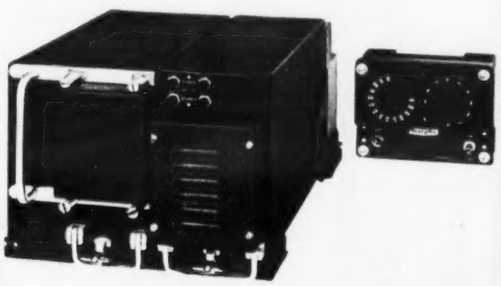
*

Increased speeds in the air have resulted in higher temperatures with a direct effect on the design of electronic equipment. Several examples of approaches to the temperature problem were shown. British Insulated Callender's Cables Ltd. showed *Uni-eglas* aircraft wiring cables which can operate continuously at 240°C, yet remain flexible down to a temperature of —75°C; another cable shown, *Tersil,* is capable of withstanding a 1,100°C flame for five minutes. The British Thomson-Houston Co. Ltd. exhibited for the first time a range of silicon rectifiers and reference diodes capable of operation at high temperatures; rectifiers at 200°C, reference diodes at 250°C. The Westinghouse Brake & Signal Co. Ltd. demonstrated lightweight blast-cooled rectifiers for main DC power supplies in aircraft, high temperature aluminium-based rectifiers and miniature rectifiers for electronic circuitry. Standard Telephones & Cables Ltd. showed silicon rectifiers for high temperature operation.

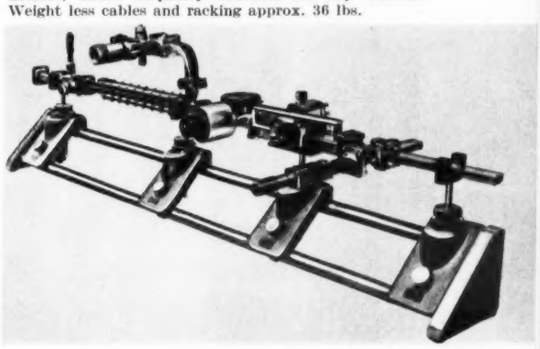
*

Increased accuracy, longer range and miniaturization are very important trends in the field of radar. Ekco Electronics Ltd. demonstrated search radar equipment designed for the Bristol *Britannia,* the new *Comet,* the Vickers *Vanguard* and the Boeing 707; Ekco also exhibited the Airfield Approach Aid combining a 3-cm. radar unit with a VHF/DF receiver providing talk-down facilities, capable of operation by one man and sufficiently compact to be mounted in a vehicle. A.C. Cossor Ltd., one of the pioneer radar firms, showed the CR.21, a high powered medium range surveillance radar with M.T.I. and circular polarization, which is not "confused" by snow or rain, and which eliminates permanent echoes from mountains and buildings; Cossor also showed the latest forms of secondary radar airborne transponders. Decca Radar Ltd. showed the Decca Interscan Display System which provides not only a picture of all available radar information filtered for simplicity, but also information on aircraft identification, position of beacons and local hazards, from non-radar sources. The Plessey Group of Companies presented an interesting new material which absorbs radar pulses instead of reflecting them; a structure covered with this material is claimed to be undetectable by radar.

The Ekco Electronics Ltd. Airfield Approach Aid contains a 3-cm. radar unit with a VHF/DF receiver providing talk-down facilities.



The Murphy MR 300 multi-channel VHF airborne transmitter/receiver provides 44 spot frequencies anywhere in the civil band (118-132 Mc/s). Transmitter power 5 W normal; direct frequency selection for any channel. Weight less cables and racking approx. 36 lbs.



A complete range of microwave (X-band and J-band) test equipment was shown on the W. H. Saunders (Electronics) Ltd. stand.

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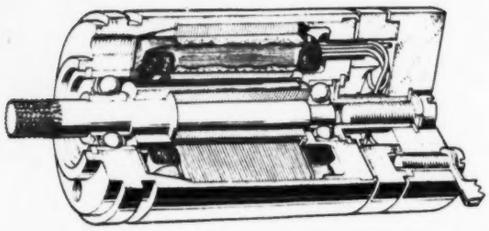
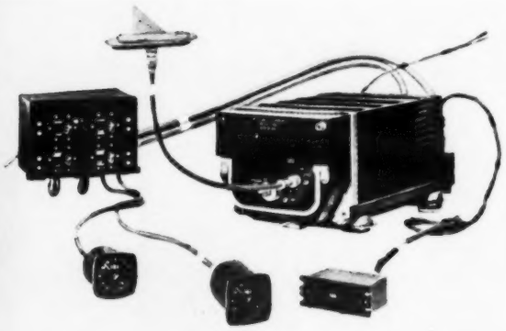
5 – W. Hampton (left, back to camera), Export Manager, and Clifford Hollowell (centre), Publicity Manager, D. Napier & Son, Ltd. **6** – H. Sammons, Managing Director, D. Napier & Son, Ltd. **7** – David Bay, Hunting Percival Aircraft. **8** – C. J. McCarthy (profile, left), Chairman, Chance Vought Aircraft, and J. J. Parkes (right), Chairman of Alvis Ltd. **9** – R. L. Lickley (right), Director and Chief Engineer, Fairey Aviation Co. Ltd., in conversation with Dr. G. Hislop, Deputy Chief Engineer. **10** – A. F. Burke (left), Managing Director, and W. E. Nixon (centre), Chairman, The de Havilland Aircraft Co. Ltd.

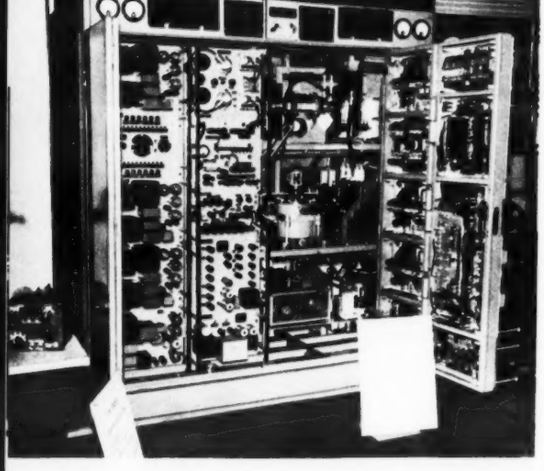
Farnborough



Sectional drawing of the Vactric (Control Equipment) Ltd. Size 11 A.C. miniature Tachogenerator, for conditions within the temperature range −65° C to +85° C. The company's production range includes A.C. and D.C. Servos and servo breadboard components for designers of automatic control and regulating systems.



Standard Telephones and Cables demonstrated the STARN. 21 airborne TACAN equipment working in conjunction with a beacon simulator.

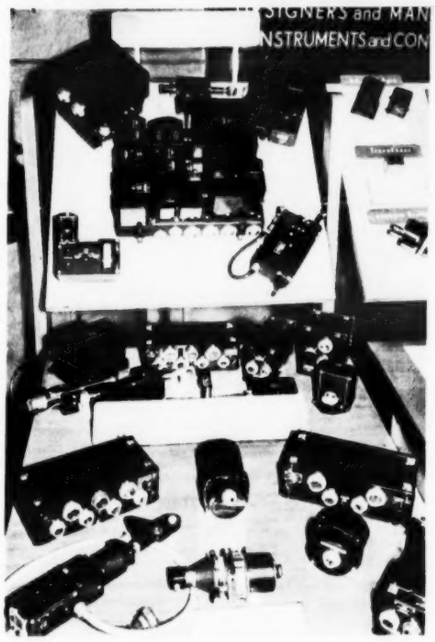


On public view for the first time was the Marconi Type SR 1000 high-power transmitter/receiver; this is a 10-cm equipment with an actual output of 3 megawatts.

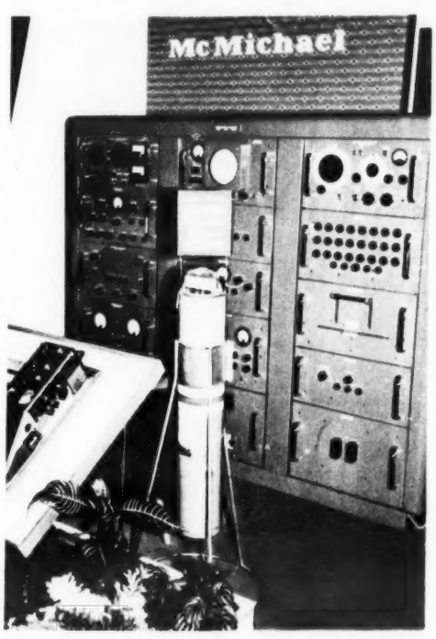
Among the outstanding radar navigation systems shown was the Marconi's Wireless Telegraph Co. Ltd. Doppler Navigator which has been in use with the R.A.F. for three years, and which is now redesigned for civil operation. The system is independent of ground-based aids and assesses speed and drift, the information being fed to a computer which translates it into navigational data, e.g., immediate position in latitude and longitude, distance covered or to go, track guidance, wind velocity and estimated time of arrival at destination. Decca Radar Ltd. also demonstrated their new Doppler radar as used in conjunction with Decca/Dectra in the DIAN system, which presents position information either on meters, showing latitude and longitude, or in the form of a track drawn on a moving chart (Flight Log). An improved direction finding system, the Commutated Antenna Direction Finder, shown by Standard Telephones & Cables Ltd., is claimed to be the most notable advance in direction finding since the introduction of the Adcock aerial; the system gives an improvement of site error suppression of the order of ten times, and horizontal polarization error is reduced by about three times; CADF is applicable to the HF, VHF and UHF bands. Standard Telephones & Cables also showed the STARN. 21 airborne TACAN equipment working in conjunction with a beacon simulator.

Economy in the training of personnel can be achieved by the use of electronic simulators, and the Solartron Electronic Group Ltd. showed a radar device which can simulate an air battle and show it on the radar screen; Solartron have contracts to supply two of these systems to the Italian Government under the N.A.T.O. defence programme.

Also exhibited was radio equipment in its most modern space and weight saving form. Some of the more interesting exhibits included: Murphy Radio Ltd.—equipment including a VHF link which carries 24 speech channels; Mullard Ltd.—a new single-sideband system which is claimed to give longer range with reduced fading and distortion; Redifon Ltd.—a medium frequency non-directional beacon as well as their new communications equipment; Philips Electrical Ltd.—their multi-channel airport tape recorders. Pye Limited showed radio communication equipment for runway control and ground-to-air communications, the Pye instrument landing system (ILS) and HF equipment for airways point-to-point radio services.



Louis Newmark Ltd. showed Autopilot and Autostabilizer equipment.



McMichael Radio Ltd. presented a Sonobuoy radio submarine detection system. The equipment is dropped by parachute and on reaching the sea automatically erects its aerial and lowers a hydrophone. Signals from a cluster of Sonobuoys are monitored in the aircraft to determine the submarine's position.

11 — Roger Whitesmith (left) and Captain Bartlett, Bristol Aircraft Ltd.

12 — Bruno Jablonsky, Managing Director, Jablo Plastics Industry Ltd.

13 — A. I. Fenwick, Public Relations Manager, Rolls-Royce.

14 — Left to right: Mrs. J. M. Laker, Mr. Edwards and F. A. Laker, Aviation Traders (Engineering) Ltd.

15 — F. G. Miles (right), Chairman and Managing Director, F. G. Miles Ltd.

16 — F. O'Shanohun (left), Assistant Managing Director, Sidney Barton Ltd., and F. Kelly, Publicity Officer, Short Brothers & Harland Ltd.

Air Travellers in Search of a Hotel

In Havana *Intercontinental Hotels Corporation*, subsidiary of P.A.A., operates the Hotel *Nacional:* 550 air-conditioned rooms, two swimming pools, the Cabana Sun Club, tennis courts and other recreational facilities, garage for 500 cars.

According to figures recently published by the United States Department of Commerce, Americans spent no less than $1,800,000,000 on foreign travel in 1956, of which total $300,000,000 went on transport, and $1,500,000,000 we spent in the actual countries visited. The stream of European travellers is probably not much smaller, and the fact that Americans and Europeans are not the only paying guests is proved by the constantly growing number of turbans, saris and kimonos seen in Western cities. The part played by the tourist trade in the economy of individual countries is revealed, for example, by Britain's trade balance for 1955, when foreign tourists took second place in the list of dollar-earning items: machinery $187,000,000, *tourist traffic* $109,000,000, whisky $78,000,000, textiles $73,000,000, chemicals $61,000,000, and private cars $41,000,000.

In other words, foreign visitors are "sound business" which must be encouraged. But, according to the Organization for European Economic Cooperation, this business is not being given proper attention at the moment. *During the summer season there is already a marked shortage of hotel accommodation in London, Paris, Rome and most other European cities, and in 1960, when jet aircraft are introduced into commercial service, there will be a need for many thousands of extra beds.*

What is even more serious is that the hotel industry is at present paying very little attention to air travellers. Whereas most of New York's larger hotels send representatives to meet the big trans-Atlantic liners, nobody bothers very much about the 2,000 travellers who arrive every day by air.

The situation is scarcely different in Paris, London, Rome or Geneva. During his last visit to Paris, the Vice President of a large American hotel company had an illuminating conversation with a French hotel manager, who complained bitterly that the *Queen Mary* was arriving late in Cherbourg and that the rooms reserved for the passengers would be empty for the night.

"Why do you rely so much on the ships?" asked the American. "Over 60% of your trans-Atlantic customers arrive by air."

"It seems hard to believe," answered the Frenchman. "The air travellers come in such small batches."

The Frenchman was mistaken. Admittedly, there is no relation between the number of passengers per aircraft and the number per ocean liner. But aircraft make more trips in a given period. From 1960 onwards they will be able to make the Atlantic crossing, for which the *Queen Mary* needs at least four days, three times every day. The result will be that each of the 300 Douglas DC-8 and Boeing 707 jet transports ordered by the world's airlines will be able to carry annually as many passengers across the "Big Pond" as an Ocean liner of the *Queens* class. And—another not unimportant point—if a passenger travels by sea, on his month's trip he will require hotel accommodation for only 14 days, whereas the air traveller requires accommodation on land for 28 days.

Even today, telephoning from the airport to already overcrowded hotels cannot be described as one of the pleasures of life. Unless something drastic is done by 1960, the tired air passenger

The swimming pool of P.A.A.'s Hotel *Del Lago* at the side of Lake Maracaibo, Venezuela.

Maracaibo's Hotel *Del Lago* offers an international cuisine.

The Hotel *Tequendama* in Bogota, Columbia, is seventeen storeys tall with 400 rooms overlooking the city and with spectacular views of the surrounding Andes mountains.

An appartment in the *Tequendama* Hotel, Bogota.

who has not previously made his hotel reservation will have no alternative but to try the local Salvation Army hostel.

*

And if in Europe and the U.S.A. there is a shortage of hotel accommodation, other air travellers to South America and the Middle and Far East come up against the additional problem of what is to be accepted as a reasonable standard of comfort; one American businessman recently commented that the standard of accommodation available in these areas is often worse than no accommodation at all. The majority of modern air travellers are not seeking a historically famous luxury hotel of the type about which Mark Twain said: "It used to be a good hotel, but that proves nothing—I used to be a good boy".

The modern air passenger is not looking for super luxury but he does want a certain standard of comfort, a good supply of hot water, adequate lighting and, last but not least, quick and efficient service organized to cope with his particular needs, as the time at his disposal is very often limited. But above all he must be assured that a room will be available for him, and not find at the end of a 3,000 mile trip that there is "no room at the inn".

The air transport company as hotelier

What is the answer? Must the air transport companies themselves enter the hotel business in order not to leave their passengers standing at the airport?

Already Pan American World Airways has taken the first step in this direction. At the suggestion of the U.S. Government, P.A.A. in 1946 set up a wholly owned subsidiary, *Intercontinental Hotels Corporation*, to provide technical assistance in the planning, construction and financing of hotels abroad and the operation of these hotels on behalf of their local owners.

The present activities of the Intercontinental Hotels Corporation are almost entirely limited to Latin America, where the company is operating the following twelve hotels: *Tamanaco* in Caracas and *Del Lago* in Maracaibo (both in Venezuela); *Tequendama* in Bogota and *Del Prado* in Baranquilla (Columbia); *Victoria Plaza* in Montevideo (Uruguay); *Reforma-Intercontinental* in Mexico City (Mexico); *Nacional de Cuba* in Havana and *Varadero Oasis* at Varadero Beach (Cuba); *Carrera* in Santiago (Chile); *Grande* in Belem (Brazil); *El Embajador* and *Jaragua* in Ciudad Trujillo (Dominican Republic). A further four hotels are under construction and will be completed within the next twelve months at Curaçao (Netherlands West Indies), San Juan (Puerto Rico), San Salvador (Salvador) and Beirut (Lebanon). The company is also presently engaged with plans for the operation and management, or leasing, of other hotels in Europe and various other parts of the world.

The company is headed by an experienced team of hotel management, sales, design and construction experts who know precisely what business travellers and tourists expect in a hotel and how to meet their requirements. Wallace S. Whittaker is Chairman of the Board, Byron E. Calhoun* is President, with Peter Grimm Vice-President of Operations. Evidence of this team's ability can be seen in the P.A.A. Annual Report for 1956 in which the Intercontinental Hotels Corporation recorded a net profit of $497,000 after taxes, compared with $286,000 in 1955.

* As these lines go to press it is learned Byron E. Calhoun died on September 4th, 1957 at the age of 54. Ed.

Expert hotelier Peter Grimm, Vice President, Intercontinental Hotels Corporation, New York. Grimm studied in European universities and speaks seven languages.

The series of P.A.A. hotels is operated with modern techniques blended with the best traditions of European hotel keeping. Bookings are heavy and in many cases have necessitated extensions which are in hand. Such hotels have not only served the immediate purpose for which they were first planned but have proved the more important point that, with air travel cutting down the time and cost factors, a good hotel will attract guests and be an economic asset to the community. The building of the Tequendama Hotel in Bogota (Columbia) more than doubled the number of international travellers arriving by air over a period of two years; in 1955 a total of 140,000 guest-days were registered for new visitors to the city who spent over $4,000,000.

*

In South America then the problem of hotel accommodation for air travellers is approaching the ideal solution. But this is of no help to the many thousands of passengers travelling to Europe and elsewhere. Will other air transport companies follow the example of the Intercontinental Hotels Corporation and carry out similar programmes in other parts of the world?

Already British Overseas Airways Corporation has had good experience with its "Rest Houses" at Bathurst, Karachi, etc. on the African and Far East routes. K.L.M. Royal Dutch Airlines has also had some success in various hotel ventures. All these ventures have been carried out without exception at intermediate stops in the wilderness of economically undeveloped areas where there was no local tourist industry in existence. What would the results be if B.O.A.C. planned to open a hotel in Paris, or if Air France or K.L.M. wished to set up as hoteliers in Frankfurt or Geneva? The answer is clear. To a man the existing local hotel industry would energetically protest that this should never be allowed.

A negative agreement would not be difficult to obtain. But what is urgently needed is a positive solution, for, and it cannot be repeated too often, in 1960 the European traffic experts are anticipating an avalanche of tourists. Tourists who wish to sleep in hotel beds, and not in tents.

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JET ENGINE CONTROL ANALYZERS

FUEL METERING SYSTEMS FOR STARTING CONDITIONS

FUEL-FLOW METERS

FUEL-FLOW DIVIDERS

FUEL-FLOW TOTALIZING SYSTEMS

FUEL SUPPLY PUMPS

SPECIALIZED FUEL METERING AND CONTROL SYSTEMS FOR GUIDED MISSILES

AIRCRAFT GUN CHARGERS (SWITCHES, CONTROL)

FUEL SYSTEM FILTERS

VENT-LINE TYPE FILTERS

HYDRAULIC—LINE-TYPE FILTERS

RESERVOIR—LINE-TYPE FILTERS

FILTERS FOR AIRCRAFT HEATERS (AUXILIARY, ENGINE, CABIN)

PNEUMATIC SYSTEM FILTERS

ENGINE STARTING EQUIPMENT, INCLUDING BOOSTER COILS, INDUCTION VIBRATORS, RELAY SWITCHES, STARTERS

AUTOMATIC ENGINE POWER CONTROLS

AUTOMATIC ENGINE BOOST CONTROLS

PROPELLER GOVERNOR CONTROLS

SUPERCHARGER REGULATOR CONTROLS

RECIPROCATING STARTER DRIVES

MAGNETOS

ELECTRICAL CONNECTORS

IGNITION HARNESSES

BOOSTER COILS

IGNITION ANALYZERS

LOW- AND HIGH-TENSION IGNITION SYSTEMS

RADIO SHIELDING HARNESSES

IGNITION SYSTEMS FOR JET AND TURBINE ENGINES

IGNITER PLUGS FOR JET AND TURBINE ENGINES

DUPLEX JET NOZZLES

DYNAMOTORS

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BAND CHANGE MOTORS

BOOSTER DYNAMOTORS

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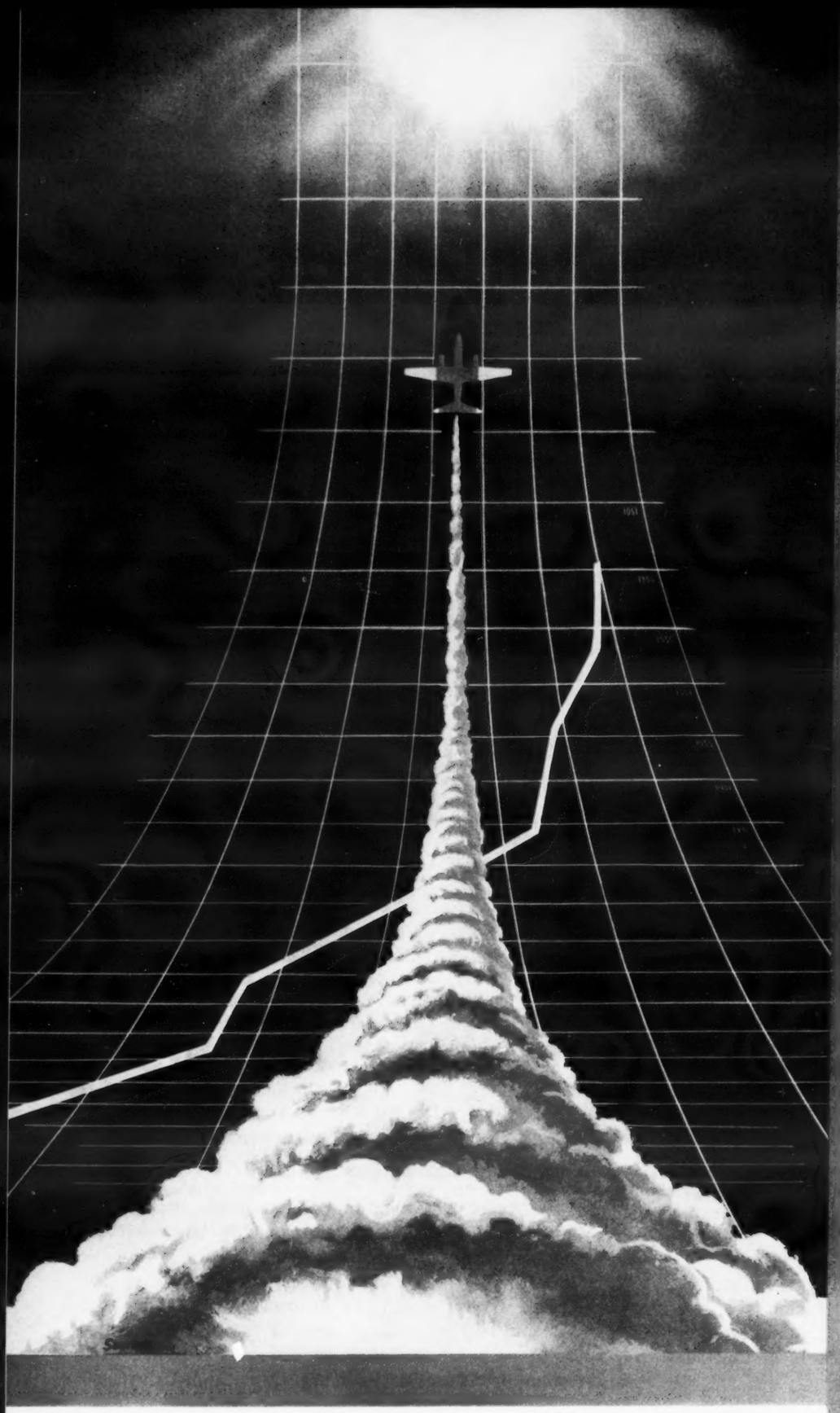

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The Turbine Engine Position in 1957

The first jet aircraft for long-range air services are already under construction, and propeller turbine aircraft have been in service on short stages throughout the world for some years. It might therefore be thought that the discussion on the efficiency, economy and safety of civil turbine engines could now be closed.

However, it should not be forgotten that a bare two years ago some doubt was expressed as to whether turbine engines were sufficiently developed to be used in long-range air traffic. Even F. B. Rentschler, Chairman of United Aircraft Corporation, in 1955 considered it unlikely that proven medium and long-stage aircraft with jet or turboprop power could take any dominant position in world air transport before the early sixties. As spokesman for one of the biggest engine manufacturing concerns, Rentschler was doubtless fully conversant with the stringent requirement repeatedly expressed, in particular by the airframe industry, namely that *engines must be one generation in advance of the airframe for which they are destined, so as not to introduce too many hazards in the testing and development of new flying equipment.*

What of the situation in 1957? Can this requirement be said to have been met at the present stage of development? The answer cannot be given in a word. The engine industries of the leading air nations will have to undertake increased efforts in the years to come, if they are to satisfy the demands of turbine traffic in the long run. However, designers need no longer worry too much about the first turbine engine types for long-range operations. Thanks to long years of military development and testing, these are now available.

The latest propeller turbines for civil use have already outpaced the piston engines hitherto used, where economy and reliability are concerned. For example, the specific fuel consumption of turboprops such as the Bristol *Orion,* Rolls-Royce *Tyne,* etc., in cruising flight is around 0.4 lbs/e.h.p./hr., and it must not be forgotten that turbine fuel is considerably cheaper than conventional aviation gasoline. Even the fuel-hungry jet engines for the coming generation of airliners (Pratt & Whitney JT3 and JT4 and Rolls-Royce *Conway*) consume only about 0.8 lbs/lb.t/hr. As regards the reliability of turbine engines, it is only necessary to mention that operating time between two basic overhauls has been raised to nearly 1,500 hours for some of the engines in service today.

Turbine engines are not a luxury

Apart from the fact that turbine engines have the obvious advantages of simple structure and vibrationless operation, there are yet other reasons why they are becoming indispensable for trans-Atlantic services. On this most rewarding of all air routes airlines are still striving to obtain non-stop flights in both directions. Because of the strong head winds on the east to west crossing, such long distances can be flown economically only if cruising speed is high. To keep the time lost due to head winds of 50 knots or more within relatively low proportions, cruising speeds of 400 to 500 knots are needed. These cannot be provided by piston engines, whose performance has reached its furthest limit, both from the structural and from the economic point of view, while turbine engines are today still working in the lower portion of their potential performance scale. This applies in particular to continuous performance at high altitudes. Although these facts are widely known, they need constant stressing, since this is one of the main reasons for the airlines' radical switchover to turbine aircraft for long-distance services. Another fact worthy of mention in this connection is that several airlines engaged on trans-Atlantic traffic are planning shortly to convert their piston-engine aircraft to turboprop power.

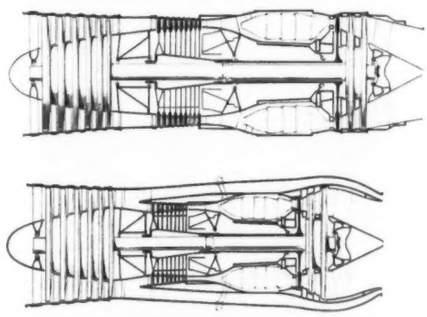
In addition to long-stage operations, turbine engines are being developed and used for a wide variety of other tasks. For example, a proven propeller turbine has been available for some years for short-stage services in the shape of the Rolls-Royce *Dart,* which with its power of roughly 1,500 s.h.p. has won a place for itself in the very power class that originally seemed likely to remain the sole province of the piston engine. Simplicity of design and long operating life between overhauls have played a not unimportant part in the success of this engine.

Finally, there is the helicopter, for which a series of interesting gas turbines and turbo gas generators has been developed. All these engines feature simple structure and low cost price, and have in addition such low specific fuel consumption that they will doubtless also oust the piston engine in rotary-wing aircraft.

The customer dictates technical development

Although there can no longer be any doubt that the turbine engine will occupy a dominant position in air transport during the next ten years, no definite forecast can yet be made of the outcome of the present controversy between the supporters of the two most important engines types in this category, namely the pure jet and the propeller turbine. What is clear, however, is that technological development is largely dependent on the airlines' widely divergent operating requirements. Pure jets, for example, are still considerably less economical, as regards specific fuel consumption, than propeller turbines; nevertheless, they have been selected for long-stage operations in the sixties. If three Atlantic crossings per day are to be made (outward flight – return flight – outward flight) by each aircraft, instead of the two possible with turboprop aircraft, an average cruising speed of a least 540 knots or Mach 0.9 will be needed—a speed which can be obtained only with pure jets. Despite higher direct operating costs, therefore, the jet aircraft will probably be as profitable as the turboprop type, because of its high utilization capacity.—The days are definitely past when the airframe manufacturer had to adapt his aircraft design as best he could to the engines available. Today the airline customer dictates his requirements to both the airframe and the engine manufacturer, who must then get together to arrive at the best solution.

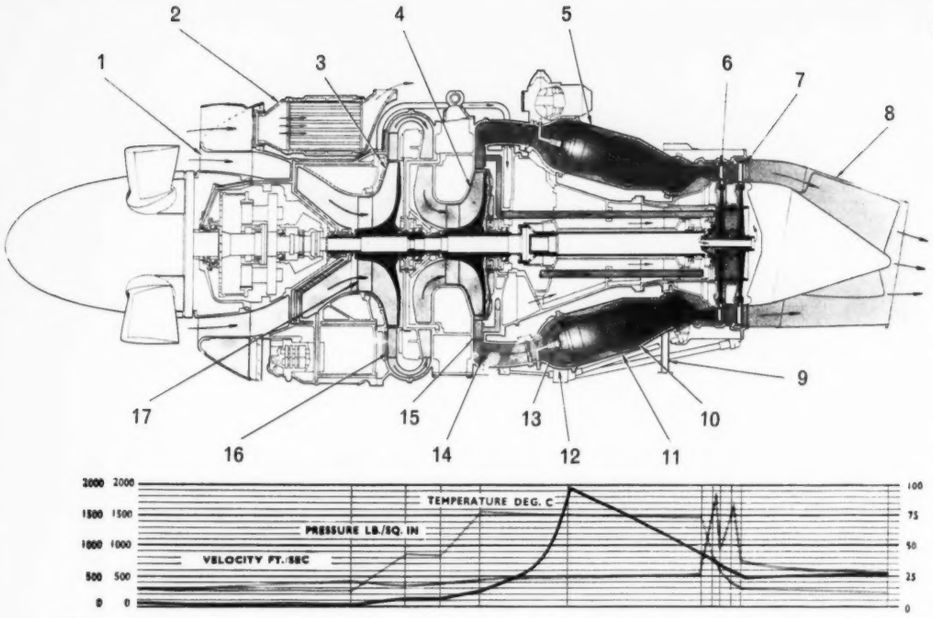
Rivals for jet operations: *Straight jet* with double compressor and separate high and low pressure turbines (top), and *by-pass engine* (bottom), also with double compressor and high and low pressure turbine. The diagram of the by-pass engine is, in essentials, that of the Rolls-Royce *Conway* and shows how the air flow forks behind the low pressure compressor, to flow through the low pressure compressor, combustion chambers and turbines on the one hand, and through the cooling jacket round the engine on the other. The fast inner flow (turbine air) and the slower outer flow (cooling air) mix on a level with the jet cone, achieving simultaneously a marked fall in noise level and an improvement in thrust efficiency.



The interdependence of engine and airframe manufacturers is even greater in the case of the military weapons system, in which the powerplant has already become an integral component of the finished operational weapon. Graphic examples of this development are the Convair B-58 *Hustler* supersonic bomber, the Lockheed F-104 *Starfighter* supersonic fighter (both powered by the General Electric J79), the Ryan X-13 experimental vertical take-off fighter (with Rolls-Royce *Avon*), the SNECMA *Atar Volant* experimental vertical take-off vehicle (with SNECMA *Atar* 8/9), the Short SC. 1 experimental short take-off aircraft (with Rolls-Royce RB.108), etc.—The list of aircraft could be continued, but even this short round-up reveals how many different methods of integrating powerplant and airframe have been tried out ... and in many cases proved successful.

In view of the growing tendency towards integration it is increasingly difficult to outline clearly the present development trends in turbine engine design. If the question is considered solely from the point of view of the engines themselves, without regard for the interaction between intake configuration, jet pipe configuration, arrangement of power units, etc., there are seven major problems to which scientists and engineers are giving increased attention:

- *Raising the compression ratio,* either by using separate multi-stage low-pressure and high-pressure compressors, with separate low-pressure and high-pressure turbines (e.g., Bristol *Olympus,* Pratt & Whitney J 57, etc.) or by use of variable compressor stator blades (e.g., General Electric J 79);
- *Use of air or liquid cooled turbine blades* to enable turbine input temperature to be raised;
- *Development of heat resistant ceramic materials or mixtures of ceramic and metallic materials for uncooled turbine blades,* also to increase turbine input temperature;
- *Better design of combustion chambers and flame tubes* to raise fuel combustion efficiency;
- *Use of cooling heat for propulsion,* for example by mixing the cooling air with the main gas flow (Rolls-Royce *Conway* bypass engine);



Section drawing of a proven propeller turbine: Rolls-Royce *Dart* with two-stage radial compressor. The lower diagram shows the velocity in ft./sec, the pressure and the temperature from the air intake to the exhaust unit.

1 - Air intake
2 - Oil cooler
3 - 1st stage rotor
4 - 2nd stage rotor
5 - Combustion chamber
6 - High pressure turbine
7 - Low pressure turbine
8 - Exhaust unit
9 - Cooling air outlet
10 - Flame tube
11 - Air casing
12 - Expansion chamber
13 - Burner
14 - Cascade vanes
15 - 2nd stage diffusor
16 - 1st stage diffusor
17 - Rotating guide vanes

- *Improvement in afterburner design* to obtain the greatest possible thrust increase for a given air mass flow.
- *Design of efficient, integral silencers* to provide optimum noise reduction with minimum loss of power.

With the exception of the last point, all these problems are directly connected with improvements in the overall efficiency of turbine engines. The use of separate high-pressure and low-pressure compressors in a number of designs has already led to substantial increases in compression ratio and hence to a reduction in specific fuel consumptions, in particular in high-altitude cruise.—When it comes to raising the turbine input temperature, there are still considerable difficulties to be overcome. Experiments with cooled turbine blades are in progress, but no fully satisfactory solution yet appears to have been found. As regards the production of heat-resistant and creep-resistant materials, the following brief comments can be made: the development of known alloys based on nickel and cobalt is slowly nearing its ultimate limit, and even at an optimistic estimate it will probably not be possible to obtain a temperature increase of more than about 50° to 100°C. Though molybdenum alloys permit a further increase in gas temperature, molybdenum has the disadvantage of oxidizing rapidly at high temperatures. Its value for turbine blades therefore depends upon the development of effective anti-corrosion coatings.

At present a number of ceramic or mixed materials are being tried out for possible use in uncooled blades. There are already cheap, readily available "ceramic alloys", which have good creep and oxidization resistance at temperatures up to +1,200°K or 1,400°K (927° to 1,127°C), but in general they are too brittle, so that there is risk of breakage under mechanical or thermal stress. Some of the latest mixed materials, such as silicon carbide, chrome aluminium, titanium carbide mixed with nickel or cobalt, etc., promise greater success, but their use will probably be restricted to stationary blades for the time being.

The importance of increasing operating temperatures, in particular in propeller turbines and bypass engines, is revealed by the following example: if the gas temperature of a propeller turbine designed for stratospheric flight is raised from 1,100°K to 1,400°K, specific power can be increased by roughly 50%, with a reduction of 10% in specific fuel consumption.

If the notion of the turbine engine is extended to cover the propulsion system as a whole, and hence to include all mechanisms concerned with propulsion, a whole series of additional problems must be mentioned, whose solution would also contribute to an improvement in overall efficiency. These include, for example, improvements in the intake configuration to increase pressure gain in front of the compressor (multi-shock diffusor for supersonic engines); better design of engine cowlings, or of the fuselage rear, to reduce harmful interaction between flow through the engine and flow round the nacelle or the missile; optimum arrangement of secondary air circuits inside and outside the engine (reduction in cooling losses, avoidance of heat build-up zones, etc.).—Here, too, a new field of activity, which the present article can do no more than outline, is opening for scientists and experimental engineers.

*

Up to the present, remarks have been confined to turbine engines and have thus concerned both civil and military aviation. Mention should now be made, however, of two other categories of powerplant, which have so far been reserved for military use, namely ramjets and rocket engines. Because of their relatively high specific fuel and propellant consumptions, neither category is yet suitable for air transport use, despite earlier forecasts to the contrary. For manned supersonic fighters and for guided missiles, however, their importance is steadily growing, thanks to their high specific power, and they are being used to an increasing extent in the form of mixed powerplant, such as jet plus ramjet, jet plus rocket engine, ramjet plus rocket engine. It is not possible to describe the present development stage reached by ramjet and rocket engines in the present article or in the table on page 1029, as—with the exception of a few modest data—detailed technical and operational information is classified. The main features of these two types of propulsion unit are discussed elsewhere in this issue. However, two basic trends can be distinguished in rocket engine development. The power-weight ratio (pounds of thrust per pound weight) is constantly increasing, and the combinations of fuel and oxidizer are becoming increasingly reliable, i.e., less dangerous to handle. Finally, the United States and the Soviet Union have succeeded in developing powerplants with max. thrusts of 100,000 to 200,000 lbs., which are designed to be capable of carrying their ballistic missiles far into each other's territory. Many setbacks have been experienced on both sides, yet the construction of these giant engines is one of the most impressive achievements of modern engineering, alongside the atomic and hydrogen bombs.

*

What is the outlook for the future? Air transport will continue to benefit from military developments and within a few years' time will have available a fully reliable and economic supersonic jet engine for flight at Mach 2. In addition, propeller turbines with increased working temperatures and improved overall efficiency will be produced and can be expected to achieve substantial cost reductions not only on long distance routes but also on short and medium stages. The design of helicopters and short take-off aircraft will doubtless make further strides, thanks to the availability of cheaper and more appropriate turbine engines, so that these aircraft categories will be able to increase their share in total air transport.

Service aviation will have to tackle the problems of the heat barrier in engine design—more than in any other field—and will ultimately arrive at the standard use of atomic plant in certain aircraft categories. Experimental units using atomic fuel are already being tested, but it will probably be several years before they reach the operational stage. Meanwhile the U.S. Air Force in particular is making strenuous efforts to give greater range and mobility to its long-range bombers and supersonic fighters. New fuels based on boron with substantially higher heat values will deliver greater thrust per unit volume than kerosene, JP4 or JP5 and thus enable longer ranges to be obtained for the same volume of fuel. Research in this new field of high energy fuels has made great strides during the past two years, and a jet engine designed specifically for their use is under development at Allison.

Nevertheless, engine designers will have to make great efforts if they are to maintain their lead over airframe designers until the first atomic powerplants become available. Then the balance may well be tipped finally in favour of the engine designer.

Borane High Energy Fuels

Generally speaking, an aircraft fuel must have the following qualities:

- high energy content per unit weight;
- high energy content per unit volume;
- easy availability and simple, safe handling;
- low cost.

Unfortunately, the majority of conventional fuels do not meet all these requirements, since one always tends to exclude another. Of late, however, Olin Mathieson Chemical Corporation and Callery Chemical Corporation, both of the United States, have developed a new series of fuels, known as boranes (boron and hydrogen compounds), which appear to satisfy all the above-mentioned demands with the exception of that of low cost.

The manufacturers have succeeded in overcoming the toxicity and explosion hazards connected with boranes, and the new high energy fuels are now being tested by the military authorities. Large-scale production of boranes is scheduled to begin in 1959, for which purpose Olin Mathieson has received a $ 36,000,000 U.S. Air Force contract, and Callery a $ 38,000,000 U.S. Navy contract for the erection of plant.

Meanwhile, Russia's Professor V. M. Myasishchev has announced in turn that the Soviet Union is also working on borane fuels.

*

One of the most important qualities of aircraft fuels is the heat value, which is indicated in *Fig. 1* for certain hydrocarbons and other fuels. As will be seen, compounds of the lighter elements have higher heat values. Although boranes contain less heat energy per unit weight than hydrogen or beryllium hydride, the latter have serious disadvantages (hydrogen: low density and cooling problems in the liquid state; low boiling point; difficulties of handling and storage.—Beryllium: limited availability; extremely toxic gases; difficult ore extraction; used in the production of atomic energy).

Present interest in boron-hydrogen compounds *(Fig. 2)* is directed in particular to pentaborane (B_5H_9) and decaborane ($B_{10}H_{14}$). Pentaborane contains more heat energy per unit weight than decaborane, though the ratio of heat value to unit volume is the reverse. It follows that fuels containing pentaborane are more suitable for large aircraft where the prime need is for low weight, while fuels containing decaborane are more likely to be considered for smaller aircraft where low volume is the deciding factor.

Another special characteristic of borane fuels is their high combustion speed, which on the one hand makes it possible to reduce the length of the combustion chamber—hence of the engine as a whole—and on the other hand reduces the danger of flame-out at high altitudes where the atmosphere is less dense.

Mention should be made of two "teething troubles" from which borane fuels are suffering, but which should be overcome in time:

- Borane fuels cannot be used in conventional turbine power units, as the solid combustion deposits from the borons would cause erosion of the turbine blades.
- Although no details of manufacturing costs have been revealed, it is believed that costs in the region of several dollars per kilogramme must be reckoned with.

Fig. 1: Heat values for certain hydrocarbons, by comparison with other fuels.

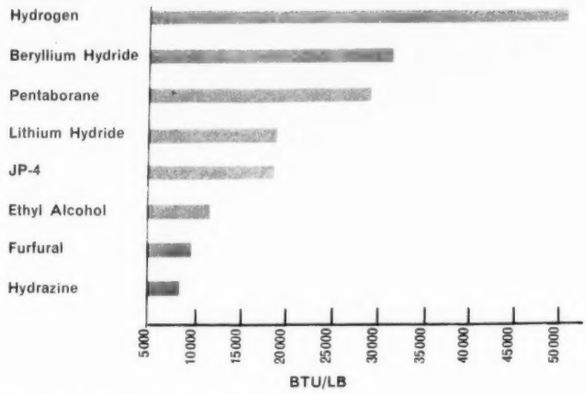
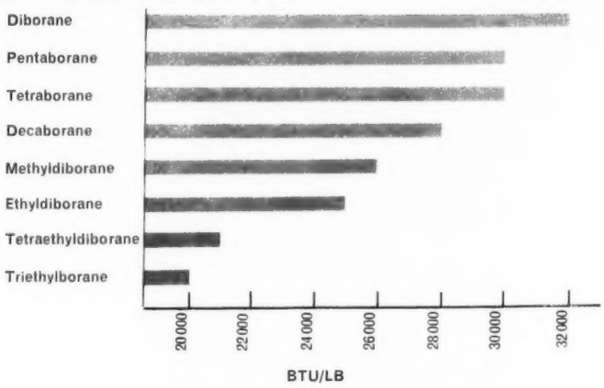


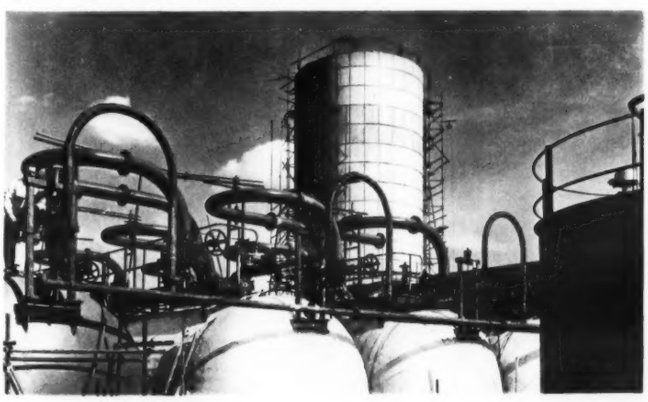
Fig. 2: Heat values for borane fuels.



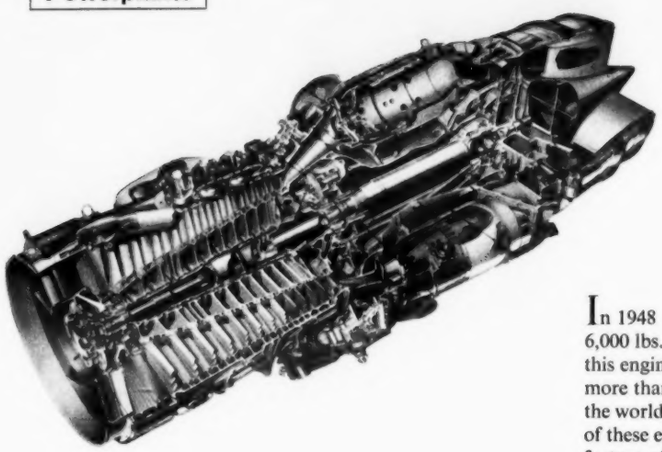
However, once large-scale production of borane fuels gets under way—presumably in 1959—their manufacturing cost should decrease rapidly, and there should be nothing to prevent their use in military and civil aircraft within a few years' time. This will greatly improve aircraft performance; in particular, range for the same fuel volume will be increased by roughly one-third, or higher speeds will be attained for the same range. Or, in the words of Professor Myasishchev: "The construction of power units for high energy fuels will probably form the transition from present-day aircraft engines to atomic powerplants."

Some of Today's Laboratories for Engine Research

Bristol Aero-Engines Ltd.'s high-altitude test installations at Filton, where experiments with the Bristol *Thor* ramjet engine were made.



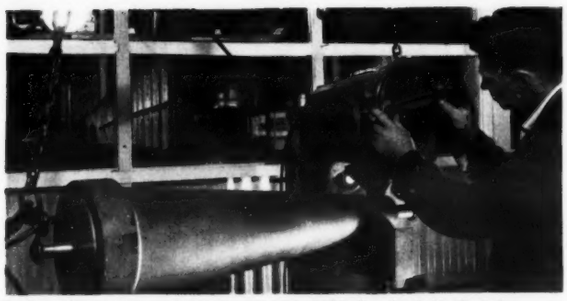
Part of SNECMA's experimental and test centre at Melun-Villaroche.



Production of a Turbojet

A Glimpse of Rolls-Royce Scottish Plant

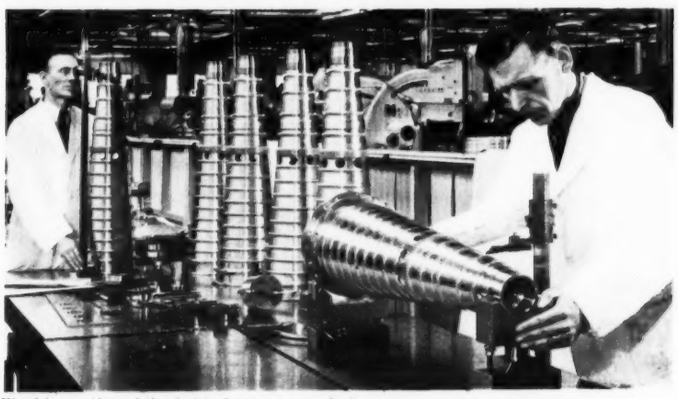
In 1948 Rolls-Royce ran the first model of a new River Class jet engine, with roughly 6,000 lbs. static thrust, on the test bench. The *Avon* was born. During the past nine years this engine has experienced an astounding development and now reaches thrust values of more than 10,000 lbs. (without reheat). Today it is in service with Air Forces throughout the world and has also been adopted by the airlines. The pictures on these pages show one of these engines in production and give some impression of what is involved in the manufacture of a reliable turbine engine. The success of a powerplant depends not only on the technical ability of its designer, but also on the rational organization of production and meticulous inspection at all stages.



Testing the hardness of the compressor shaft after heat treatment.

Inner cutting of compressor shaft.

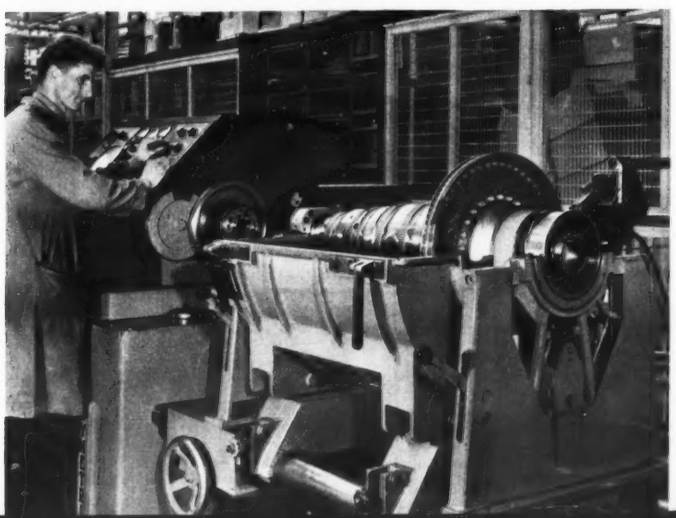
Machining the compressor wheels.



Final inspection of the finished compressor shaft.

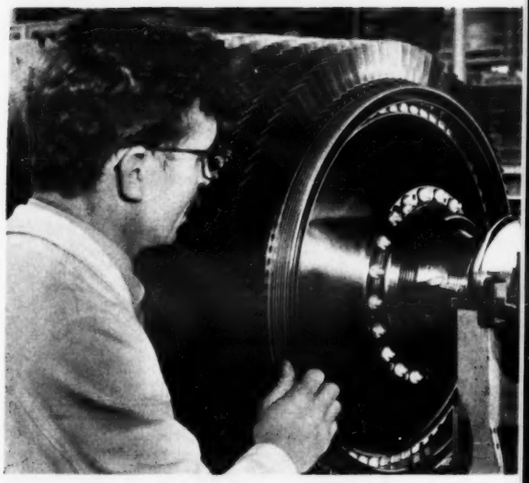
Checking the pin holes in a compressor wheel.

Balance check of the compressor with one wheel.

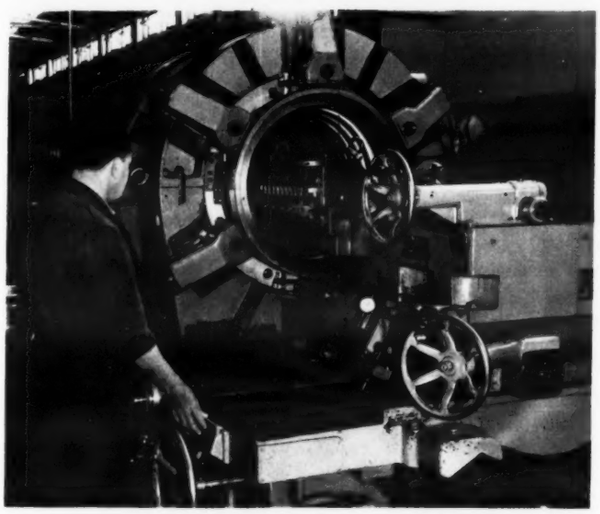


Broaching the turbine disc.

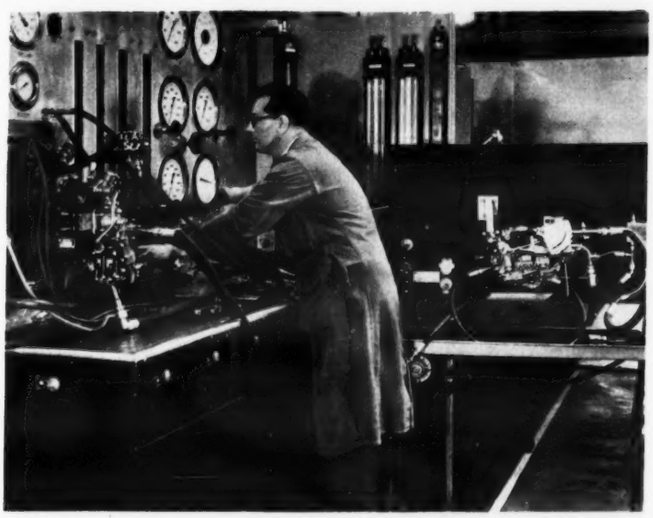
Inspecting the blade root.



Final inspection of the complete compressor.

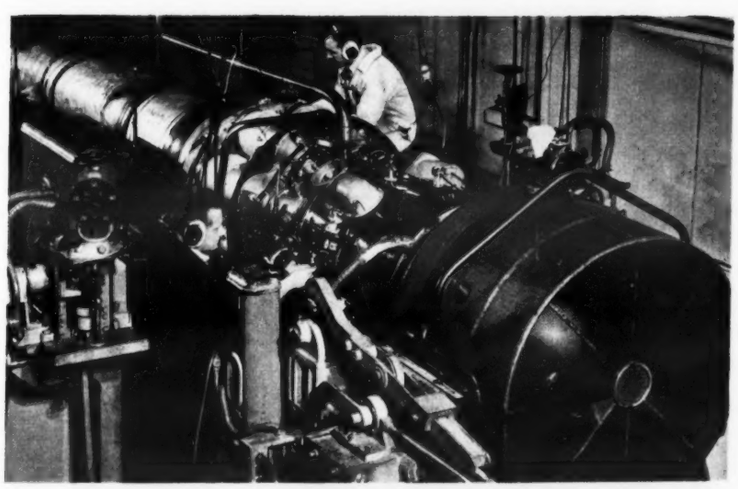


Centre machining of the compressor casing.



Checking the fuel system.

Final assembly of engines.



Test run on the bench.

Packing for dispatch.

The Power for Supersonic Flight

Problems and Prospects for Tomorrow's Powerplants

Turbojets with and without reheat, ramjets, liquid-propellant rocket engines . . . there is no lack of power systems for supersonic flight. What varieties of engines are most suitable for the different operational missions and what difficulties designers and users must solve are, however, other questions.

Needless to say, the Air Force has the last word at present in matters of supersonic flight. For a good many years to come, it will be using, in addition to missiles, two different categories of aircraft, around which the whole controversy about the best type of propulsion centres:

1 — *Supersonic fighters* for short and medium ranges with exceptional rates of climb and max. speeds, and adequate manoeuvrability at high altitudes;

2 — *Supersonic bombers* with ranges of more than 2,700 nautical miles and service ceilings — the military demand — higher than that of the fighters. Admittedly, the characteristics of the two aircraft categories tend to overlap as the bomber's speeds advance further into the Mach scale[1]. Nevertheless, it makes a vast difference to the engine manufacturer whether his powerplants must operate at temperatures of around 1,000 °C for several hours — as in a bomber — or only for a matter of minutes — as in a fighter. The supersonic bomber is primarily required to have the lowest possible fuel consumption, while the fighter engine must in general have high specific power, high power/weight ratio and small frontal area. The fact that the present fastest production fighter and the fastest bomber (Lockheed F-104A *Starfighter* and Convair B-58 *Hustler*) are both fitted with the same engine type is due rather to the limited selection of proven engines available than to technical considerations.

[1] cf. *Interavia* No. 1, 1957, p. 33 etc.

Different tasks — different powerplant?

What are the outstanding features of the above-mentioned powerplant categories — turbojets with or without reheat, ramjets, rocket engines — and how far do these features meet the requirements that will be made of fighters and bombers?

The operating characteristics of the four engine categories have been widely and exhaustively discussed in aviation literature of the past few years. The following is therefore merely a brief summary of those features that are of particular interest in connection with the problems handled later in the article.

The *turbojet without reheat* distinguishes itself at high subsonic speeds and in the lower supersonic range up to roughly Mach 2 by relatively low specific fuel consumption and satisfactory thrust characteristics. However, thrust falls off rapidly with increasing altitude, and power/weight ratio is lower than that of any of the following powerplant categories.

The *turbojet with reheat* has the admitted disadvantage of higher specific consumption, but on the other hand provides considerable extra thrust for higher power/weight ratios and increasing speeds.

The *ramjet engine* has an uneconomical consumption up to speeds of Mach 2 or more and, at relatively low speeds (for example, in the transonic range and below), delivers only very low thrust, which eventually falls to zero as speed decreases. Ramjet aircraft therefore require auxiliary power units for take-off.

The *liquid-propellant rocket engine* consumes a considerably higher quantity of fuel, or rather propellant (16 to 20 times as much as the turbojet, because of the necessity of carrying an oxidizer), but has the highest power/weight ratio of any of the engine categories mentioned. Another advantage is that its thrust and its consumption remain roughly constant at all altitudes and at all speeds.

There is, however, one basic engine requirement that applies to both fighters and bombers: both require roughly three times as much thrust for flight at Mach 2 and altitudes of around 33,000 ft. as for flight at Mach 1. At Mach 3 as much as seven times the thrust is needed to overcome the sharply increasing drag. In future,

Starboard engine nacelles in the Convair B-58 *Hustler* supersonic bomber. The variable, conical central bodies (multi-shock diffusors) are clearly discernible in the circular air intake openings.

Air intake in the Lockheed F-104A *Starfighter* supersonic fighter. The space between the fuselage side and the inner wall of the intake duct ensures that no "inert" boundary layer air enters the engine compressor.

therefore, thrusts will have to be a great deal higher than for today's transonic combat aircraft. Though the power/weight ratios of supersonic engines will doubtless increase, compared with today's values, specific fuel or propellant consumption may well one day become a bottleneck in continued development – for fighters as well as for other aircraft categories.

In view of the bomber's constantly growing cruising speed and operating altitude (roughly Mach 1.5 and 50,000 ft. for the B-58 *Hustler*), the fighter must have exceptional rate of climb and good acceleration capability. The future supersonic fighter's flight plan is unlikely to include periods of constant speed or altitude. Already becoming more and more like a projectile, the fighter will have to be repeatedly accelerated (or braked) during its relatively brief operation, for which purpose high excess power (and efficient air brakes) will be essential. In addition, close turns meet with much greater drag increases in the supersonic than in the subsonic range. In other words, in view of the necessarily high wing loading of supersonic fighters, the required manoeuvrability can be obtained only with high excess thrust. As a rule, the excess power needed is well above the take-off power and sets the airframe and engine designer serious problems.

If we consider the engine-plus-fuel weight required for a given endurance, we find that the shorter the required time of climb to a given altitude, the more unfavourably the turbojet compares with the rocket engine. In other words, the greater the rate of climb demanded, the more favourable the rocket engine appears. If, for example, an altitude of 50,000 ft. is to be reached in 1.5 minutes, the engine-plus-fuel weight for either a rocket or a turbojet would be approximately the same – assuming an ideal aircraft design in both cases. As, however, in practice the operational endurance required of a fighter will be considerably longer, efforts have been made to solve the problem by combining a rocket engine (for rapid climb and turns at high altitude) with a turbojet (for the other flight phases). Such mixed powerplants are to be found, for example, in France's SO.9050 *Trident* supersonic fighter and Britain's Saro SR.53 experimental fighter. If it is remembered that the thrust of a turbojet at 50,000 ft. is only about 20% of its sea level thrust, while the thrust of a rocket engine even rises slightly with increasing altitude, the advantages of mixed propulsion are obvious. Moreover, a fighter with mixed propulsion would consume more fuel and propellant during climb, for the same or slightly lower engine-plus-fuel weight, than the fighter with pure jet power. It would therefore be lighter on reaching its operating altitude, an advantage during subsequent combat.

Admittedly, specifications for fighters vary considerably. Apart from optimum climb performance and manoeuvrability, there is a multitude of other factors to be taken into consideration. It is not always possible to engage an enemy bomber after only a short time in the air, and this requirement for longer range has led

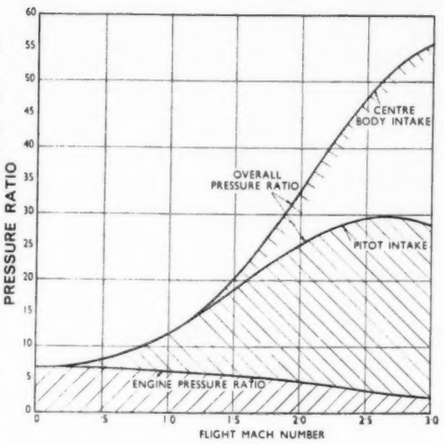


Fig. 1: Utilizing the ram pressure for engine compression (supersonic flight at 36,000 ft.). – From "De Havilland Gazette", E. S. Moult.

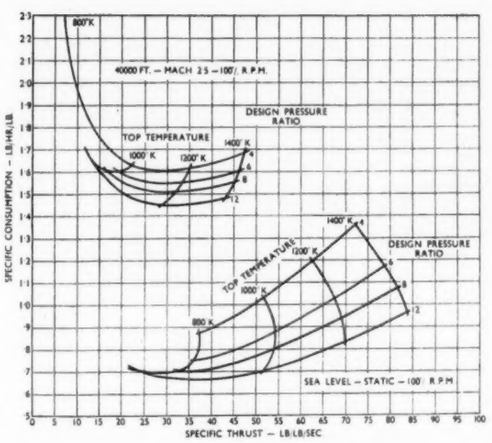

SPECIFIC CONSUMPTION – LB/HR/LB
SPECIFIC THRUST – LB/LB/SEC
40000 FT. – MACH 2.5 – 100% R.P.M.
DESIGN PRESSURE RATIO
TOP TEMPERATURE
SEA LEVEL – STATIC – 100% R.P.M.

Fig. 2: Design parameters for turbojets: specific consumption and specific thrust plotted against top temperature and design pressure ratio. The group of curves at the top left refers to full power at Mach 2.5 and an altitude of 40,000 ft., while those at the bottom right are for full static power at sea level. – From "De Havilland Gazette", E. S. Moult.

a number of aircraft manufacturers to equip their supersonic fighters solely with turbojets, despite the advantages of mixed propulsion: for example, Lockheed in its F-104A *Starfighter*, Chance Vought in the *Crusader*, English Electric in the P.1B, etc. Another form of mixed propulsion, turbojet plus ramjet, has been tried out, for instance, in the Republic F-103 and Nord 1500 *Griffon* experimental fighters. Basically, the turbojet with reheat must be regarded as a representative of this category, with the "ramjet" (afterburner) being fed with hot exhaust gases from the turbojet. However, the full advantages of ramjet propulsion are not obtained in this arrangement.

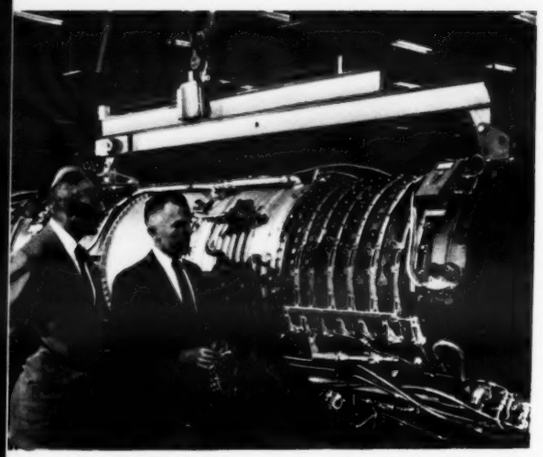
For the *supersonic bomber* conditions are a good deal simpler. In order to achieve the greatest possible range, it must of necessity have low fuel consumption, so that typical supersonic powerplants with good ram pressure recovery and high gas temperature represent at the moment the only economic form of power. Particular difficulties will probably arise through the aerodynamic heating of engine intakes and nacelles after lengthy supersonic flight. The reliable functioning of "air-breathing" jet engines can be seriously affected by overheating of the compressor and air ducts. Special cooling devices and extremely careful configuration of all parts of the engine and intakes affected by the air flow therefore appear essential. – The high thrust requirement of a 100-ton supersonic bomber cannot be substantially reduced even if the ideal airframe configuration is found. Only by cutting specific fuel consumption can range be increased. The borane fuels described elsewhere in this issue will, thanks to their high heat values, enable radius of action to be increased for the same fuel volume and lower weight. This can already be foreseen as a definite advantage for the future turbojet, which appears to be the most promising candidate for the supersonic range for some time to come.

Turbojets for another ten years

Two fundamental laws determine the overall development trend in supersonic turbojets: the increase in both the ram pressure (pressure of the ram air in front of the engine intake) and the ram temperature (temperature of the ambient air piled up ahead of the aircraft or missile) are proportionate to the square of the flying speed. The first law is welcomed by the designer, since it helps him to increase the compression ratio and hence the overall efficiency of his powerplant. The second, however, sets him serious problems. Even for the airframe designer, the heat barrier is a substantial obstacle; for the engine manufacturer it can become insuperable above a certain speed, as revealed by the following figures.

In the stratosphere the temperature of the ram air in front of the engine intake at Mach 2 is about 115°C, but at Mach 3 it has risen to 335°C. Near the ground the situation is still more critical. Here the ram air temperature at Mach 2 is 245°C, and at Mach 3 no less than 545°C. It is obvious that such high air temperatures in the engine intake require quite a different overall design than, for example, in the transonic range. At any rate such high intake temperatures entail marked power losses, not to mention new problems for the already overworked metallurgist.

Progress in engine design: The General Electric J 79 supersonic turbojet (black silhouette) weighs less and is smaller than the General Electric J 47 subsonic engine (black outline), but delivers twice the thrust.



Variable compressor blades (right) in the J 79 ensure optimum compression ratio throughout the speed range and render flow break-away in the compressor practically impossible.

The intake determines efficiency

As regards the utilization of ram pressure to increase compression ratio, the design engineer has several ways of improving the thermal efficiency, reduced by excessively high ram temperatures, and hence of compensating for the power loss. Before the ram air enters the compressor it is pre-compressed to a multiple of the ambient pressure, so that the compressor can be built with fewer stages and hence lower weight and smaller bulk. Assuming ideal configuration, a pressure ratio of 12 : 1 can be obtained, for example, with a simple pitot intake at Mach 3, or even as much as 24 : 1 with a more complicated intake with central body (multi-shock diffusor). Admittedly the effective compression ratio of the compressor decreases with increasing Mach number, because of the above-mentioned rise in ram temperature. But even if this ratio falls, in the case of a typical supersonic compressor with few stages, from roughly 7 : 1 in the subsonic range to roughly 2.5 : 1 at Mach 3, the total compression ratio of intake and compressor would still be two and a half times the ram pressure recovery, i.e., 30 : 1 for the engine with ideal pitot intake, and nearly 60 : 1 for the engine with multi-shock diffusor. When it is remembered that turbojets work at overall compression ratios of at most 15 : 1 in the subsonic range (without notable "ram pre-compression"), the astounding possibilities of supersonic engines become evident. At the same time it is clear why the efficiency of a turbojet for higher supersonic speeds depends primarily on the correct utilization of the ram pressure, i.e., on the configuration of the air intake.

As was illustrated by the Convair B-58 *Hustler*, a great deal of research and development work is often required before the optimum intake configuration is arrived at. The intake must operate with full reliability throughout the speed range and in all attitudes, and may not be disturbed either by flow break-away or by surging. The most promising—but by no means mechanically the simplest—solution is the multi-shock diffusor with automatic adjustment for the most favourable intake section at any given moment. This is the solution adopted by Convair (B-58), Lockheed (F-104A) and apparently English Electric (P.1B), as well as the Russian designer Sukhoy (experimental delta-wing supersonic fighter).—To ensure adequate cooling of the engine accessories and the lubricant circuit, a secondary air circuit will have to be provided in most cases; this secondary flow could also compensate for the negative pressure in the intake at low speeds.

The high-temperature powerplant

Compression ratio and intake configuration are not the only parameters in the design of supersonic powerplants. Since it is closely connected with the compression of the intake air, the combustion or turbine inlet temperature merits special mention. Power and efficiency of the supersonic powerplant can be even more sharply influenced by the turbine inlet temperature than by the compression ratio.

From the thermodynamic point of view, a turbine engine should work at the highest possible gas temperature. To keep specific fuel consumption constant for a rise in flying speed from Mach 1 to Mach 3, for example, the turbine inlet temperature would have to be increased from 1,100 °K (at Mach 1) to 1,375 °K. If operating temperature is raised slightly above the value required for minimum fuel consumption, the specific consumption also rises slightly, but at the same time specific thrust[2] increases so substantially that engine weight and frontal area can be greatly reduced.

To a certain extent, the advantages of increased temperature—at any rate where thrust is concerned—are already utilized in the form of afterburners. However, it would be much more economical to produce the afterburner's high gas temperatures in the actual combustion chamber, i.e., in front of the turbine, instead of pumping large quantities of fuel into the jet exhaust pipe. With afterburner in operation, the higher turbine inlet temperature would produce only relatively small improvements. On the other hand, the approximate thrusts of a reheat engine could be obtained by a high-temperature engine, for a roughly 25 % lower fuel consumption.

One obstacle to the development of high-temperature engines, however, continues to be the absence of suitable turbine blades. If the search for new heat-resistant materials should be unsuccessful, the only remaining solution would be to develop methods of cooling blades made of existing materials. The removal of large amounts of heat from the turbine blades, however, would simultaneously reduce the gas temperature at the rear stages, so that the engine's overall efficiency would suffer. Another power loss results from the energy consumed in circulating the cooling fluid, not to mention the increased weight of the blades. These factors must be carefully weighed in the design of cooling systems.

The most important cooling methods under consideration are: (a) pure liquid cooling; (b) combined liquid and air cooling; (c) pure air cooling. All systems with convective cooling through liquids depend for their efficiency on the formation and strength of the field of gravity in the rotor blade (up to 20,000 g), by which the heated and hence lighter fluid is displaced in radial direction towards the blade root. These cooling methods are therefore suitable only for rotor blades. Cooling the blades by means of fuel appears to be too hazardous for several reasons, and would hardly be satisfactory, because of the low specific and latent heat of hydrocarbon fuels. The least complicated method would appear to be pure air cooling, with the cooling air most advantageously being bled off a high-pressure stage of the compressor, passed through the turbine blade tip and finally mixed again with the main air flow. However, the cooling air required would be 1.5 to 2 % of the total compressor air mass flow per turbine stage. Incidentally, the problems of manufacturing reliable cooled turbine blades are still by no means solved.

The construction of supersonic engines also raises a number of other problems, such as, for example, that of combustion chamber configuration. The design of the combustion chamber is of decisive importance in the supersonic engine, since air mass flow and flow speed are considerably higher than in the subsonic engine. Details of high-intensity combustion have been under study for some years, with a view to achieving the combustion of large quantities of fuel in the smallest possible volume without excessive pressure losses. Apparently some of these difficulties can be overcome by using fast-burning high-energy fuels based on boron. Nevertheless, extensive research will have to be undertaken before all questions concerned with fuel combustion at very high altitudes and very high speeds can be satisfactorily solved.

Simpler, lighter, more powerful . . .

In conclusion, it can be said that the typical supersonic turbojet will have a smaller and simpler compressor, as the major part of the compression work at high speeds will be done in the intake. Thanks to the high compression ratio, specific fuel consumption of this engine should remain acceptable, even at high altitudes. If the gas temperature is raised, substantial thrust increases can be obtained, without sensible increases in consumption. In short, the future turbojet will be distinguished by favourable power/weight ratio and simple structure, so that it is likely to maintain its dominant position in aviation at least for the next decade.

Nevertheless, service aviation will not be able to manage without ramjet and rocket powerplants, and the vast experience of these two engine categories amassed by the missile manufacturers will doubtless also benefit air transport at some future date.

[2] Specific thrust is the thrust per unit consumption (fuel plus air) per unit time.

References:
M. C. Martin (Convair), "Supersonic Bomber Propulsion Problems"
E. S. Moult (de Havilland), "Powerplants for Supersonic Flight"
H. J. Brennan (Saunders-Roe), "Mixed Power"
D. G. Ainley (National Gas Turbine Establishment), "The High Temperature Turbo-Jet Engine".

AIRCRAFT ENGINES IN 1957

The following list of the major aircraft power units is restricted to models which are either in production or have reached a stage of development where production can start shortly. Very small gas turbines and other auxiliary power units for aircraft or ground use have not been included, and only those rocket engines are mentioned which are used to power piloted aircraft. As information on ramjet engines is still secret in the overwhelming majority of cases, no systematic tabulation of this engine category has been possible.

COUNTRIES

CAN — Canada
CSR — Czechoslovakia
DEU — Germany
ESP — Spain
FRN — France
GBR — Great Britain
ITL — Italy
JAP — Japan
POL — Poland
SOV — Soviet Union
SVE — Sweden
USA — United States

STRUCTURE

A — Axial compressor
R — Radial compressor
LP — Low pressure part
HP — High pressure part
O — Annular
B — Burner
FL — Flame tube
S — Output shaft
K — Combustion chamber

UNITS OF MEASURE

Dimensions : 1 m = 39.37 ins.
1 cm = 0.3937 ins.
1 dm³ = 61.024 cu. ins.

Weight : 1 kg = 2.205 lbs.

Thrust : 1 kp (kilopond) = 2.205 lbs.

LAYOUT

A — Turbojets

Single radial compressor

Single axial compressor

Double axial compressor and double turbine

Double axial compressor with bypass flow and double turbine

Axial/radial compressor

Radial/axial compressor

B — Propeller turbines

Single axial compressor

Single axial/radial compressor

2-stage radial compressor

Axial/radial compressor and free turbine for shaft power

Double axial compressor and double turbine with low pressure part for shaft power

C — Turbines for rotary wing aircraft

Single axial compressor and free turbine for shaft power

Single radial compressor

Axial/radial compressor and free turbine for shaft power

Single axial compressor and free turbine for auxiliary compressor

D — Turbo gas generators

Single axial compressor for compressed air from the main compressor

Single radial compressor for compressed air from the main compressor

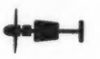
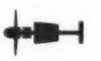
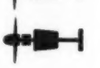
Single axial compressor with auxiliary compressor for compressed air bleed

A — TURBOJETS

Manufacturer	Type designation	Structure: Layout	Structure: Compressor Stages	Structure: Combustion Chamber	Structure: Turbine Stages	Main Dimensions: Length m	Main Dimensions: Max. Ø (Height) m	Main Dimensions: Dry weight kg	Compression ratio	Air mass flow kg/sec	Static thrust / Thrust with reheat kp	Rev. speed r.p.m.	Specific fuel consumption kg/kp/hr	Remarks
CAN														
Orenda Engines	Orenda 14		10 A	6 sep. FL	2	3.12	1.07	1 160	∼6 : 1	58	3 450	7 800	0.9	
	Iroquois		HP part LP part	0	HP part LP part	∼7.60	∼1.20	∼2 250	∼8 : 1	∼150	∼10 000 ∼13 600	—	—	Reheat; flight testing since early 1957
ESP														
Instituto Nacional Industrial (INI)	INI.11		A	0	1	∼3.0	∼0.75	450	∼5 : 1	—	∼2 000	—	∼1.0	Designed in conjunction with Hispano
FRN														
Dassault	R.7		7 A	0 12 B	1	1.99	0.68	340	3.8 : 1	25	∼1 400	11 800	1.09	Several prototypes under design
Dassault	MD.30 Viper		7 A	0 12 B	1	1.68	0.62	235	3.5 : 1	14.2	745	13 400	1.09	Licence version of the A.S. *Viper*
Hispano Suiza	R.804		7 A	0 10 B	1	3.70	0.80	350	4.8 : 1	26	1 500 2 000	12 000	1.07 —	Reheat
SNECMA	Atar 101F		7 A	0 20 B	1	5.80	0.92	1 160	∼4.5 : 1	∼50	3 000 3 800	8 300	1.02 2.0	Reheat
SNECMA	Atar 9		9 A	0 20 B	2	6.70	0.86	1 250	6.9 : 1	68	4 250 6 000	8 400	1.15 2.1	Reheat; supersonic engine for *Mirage II'*
Turboméca	Arbizon II		1 A+1 R	0	1	1.25	0.50	104	—	—	250	34 000	0.95	
Turboméca	Gabizo		1 A+1 R	0	1	3.64	0.67	340	5.1 : 1	20	1 100 1 540	17 500	1.05 2.25	Reheat; for light-weight strike aircraft
Turboméca	Gourdon		1 R	0	1	1.32	0.57	172	—	—	640	—	1.0	
Turboméca	Marboré II		1 R	0	1	1.06	0.57	135	4.0 : 1	8	400	22 600	1.1	
GBR														
Armstrong Siddeley	Sapphire ASSa.7		13 A	0 24 B	2	3.35	0.95	1 400	9.0 : 1	∼80	5 000	8 600	0.88	Also in production with short afterburner
Armstrong Siddeley	Viper ASV.10		7 A	0 24 B	1	∼1.80	0.61	260	4.0 : 1	19	910	13 400	1.01	The *Viper ASV.11* delivers roughly 1,110 kp thrust for same weight
Blackburn	Palas 600		1 R	0	1	1.10	0.45	76	4.1 : 1	3.2	177	35 000	1.20	
Blackburn	Marboré		1 R	0	1	1.09	0.56	140	3.9 : 1	7.6	400	—	1.15	

Manufacturer	Type designation	Structure				Main Dimensions			Compression ratio	Air mass flow	Static thrust / Thrust with re-heat	Rev. speed	Specific fuel consumption	Remarks
		Layout	Compressor Stages	Combustion Chamber	Turbine Stages	Length m	Max. ø (Height) m	Dry weight kg		kg/sec	kp	r.p.m.	kg/kp/hr	
Bristol	Olympus BOl.6		5 A - LP 7 A - HP	0 8 FL	1 HP 1 LP	∿3.87	1.04	∿1 650	∿10 : 1	—	7 260	—	∿0.75	For *Vulcan B.2*
Bristol	Orpheus BOr.3		7 A	0	1	∿2.44	0.82	368	4.8 : 1	36	2 200	9 600	1.06	BOr. 12 for 3,090 kp static thrust under development
Bristol	BE.47		7 A - LP 5 A - HP	0 10 FL	1 HP 2 LP	∿2.40	1.02	—	—	—	∿3 630	—	—	For B.E.A.'s medium range jet aircraft
De Havilland	Gyron DGy.2		7 A	0 17 B	2	∿3.90	1.18	∿1 800	—	∿135	∿9 000	—	∿1.0	Supersonic engine; roughly 11,350 kp thrust with reheat
De Havilland	Gyron Junior DGJ.1		6 A	0 13 B	2 or 3	2.25	∿0.85	∿700	—	—	∿4 500	—	—	Supersonic engine for Saro P. 177
Rolls-Royce	Avon RA.21		12 A	8 sep. FL	2	2.59	1.07	1 140	7.5 : 1	∿70	3 630	7 900	0.92	Also in production with afterburner
Rolls-Royce	Avon RA.29		16 A	0 8 B	3	3.17	1.07	1 320	10 : 1	∿72	4 760	8 000	0.78	
Rolls-Royce	Conway RCo.10		A - LP A - HP	0 10 B	HP LP	3.35	1.07	∿1 500	∿10 : 1	—	7 485	—	0.70	
Rolls-Royce	Soar RSr.2		A	0	1	1.72	0.40	121	—	—	840	18 600	1.25	
ITL														
Fiat	Fiat 4002.001		1 R	0	1	0.88	0.57	88	4 : 1	5	325	25 000	1.25	
JAP														
Japan Jet Engine Co.	J-3-1		8 A	8 sep. FL	1	2.77	0.69	∿450	4.5 : 1	19	1 200	13 000	1.08	Under test
SVE														
Svenska Flygmotor	Avon RM5A		12 A	8 sep. FL	2	3.10	1.07	1 340	6.5 : 1	54	3 600 4 300	7 800	0.92 1.90	Reheat; licence version of an *Avon* of the 100 series
SOV														
State Aircraft Engine Industry	RD-45		1 R double-sided	9 sep. FL	1	2.45	1.28	∿850	∿4.5 : 1	50	∿2 700	12 500	1.0	Copy of the Rolls-Royce *Nene*
	Klimov VK-1		1 R double-sided	9 sep. FL	1	—	—	—	—	55	∿3 100	13 000	1.0	Development of the RD-45
	Mikulin M-209		8 A	0 10 FL	2	∿5.00	∿1.35	∿2 500	∿7 : 1	∿125	∿8 000	6 500	0.9-1.0	Civil version with reduced power in production.
	Lyulka		A	0	2	—	—	—	∿8 : 1	∿60	∿4 000	6 100	—	Civil version in production
USA														
Allison	J-71-A-11		16 A	0 10 FL	3	4.85	0.94 (1.21)	1 860	8.3 : 1	73	∿4 600	6 100	0.8	Variable jet nozzle; J71-A-2 version with reheat; thrust 6,350 kp
Continental	J69-T-9		1 R	0	1	1.32	0.67	1 560	4 : 1	8	420	22 700	1.1	Development of the Turboméca *Marboré*
Fairchild	J44-R-20		1 R+A	0 12 B	1	2.25	0.56	152	2.5 : 1	11.4	455	15 780	1.5	
Fairchild	J83-R		A	0	—	—	—	136	—	—	∿900	—	—	Under development for the Fairchild M-185F
General Electric	J73-GE-3		12 A	0 10 FL	2	4.54	0.94 (1.14)	1 650	7 : 1	70	4 100	8 000	0.9	Variable jet nozzle
General Electric	J79-GE-1		17 A	0 12 B	3	5.20	0.82	1 450	∿12 : 1	∿75	5 000 7 700	—	∿0.8	Reheat; supersonic engine with variable stator blades; civil version CJ-805 with 4,750 kp thrust
General Electric	J85-GE		A	0	—	—	—	∿135	—	—	1 130	—	—	Version with reheat in design
Pratt & Whitney	J52-P-2		A	0	—	—	—	—	12.5 : 1	—	∿3 400	—	∿0.8	Projected for installation in the DC-9
Pratt & Whitney	J57-P-13		9 A - LP 7 A - HP	0 8 FL	1 HP 2 LP	5.90	1.06	2 500	12.5 : 1	78	4 950 6 600	8 000 LP	0.8 1.95	Reheat; variable jet nozzle; version with longer afterburner up to 7,800 kp thrust
Pratt & Whitney	J57-P-31		9 A - LP 7 A - HP	0 8 FL	1 HP 2 LP	4.60	1.02	∿1 900	12.5 : 1	82	5 900	8 000 LP	0.8	Civil version JT3
Pratt & Withney	J75-P		—	0	—	5.40	∿1.10	∿2 400	12.5 : 1	115	7 800	10 000	—	Supersonic engine; version with reheat up to 11,000 kp thrust; civil version JT4
Westinghouse	J54-WE-2		16 A	0 24 B	2	4.00	0.89	∿635	8 : 1	45	2 950	—	0.85	Projected in particular for installation in guided missiles
Wright	J65-W-6		13 A	0 36 B	2	4.95	0.96	1 260	7 : 1	54	3 500 5 100	8 200	0.92 1.98	Reheat; development of the A.S. *Sapphire*
Wright	TJ38 Zephyr		5 A - LP 7 A - HP	0 8 FL	1 HP 1 LP	3.35	1.04	1 635	10.5 : 1	—	5 700	—	0.72	Developed from the *Olympus* in cooperation with Bristol; designed for civil use

B — PROPELLER TURBINES

Manufacturer	Type designation	Structure: Layout	Structure: Compressor Stages	Structure: Combustion Chamber	Structure: Turbine Stages	Main Dimensions: Length m	Main Dimensions: Max ∅ (Height) m	Dry weight kg	Compression ratio	Air mass flow kg/sec	Shaft power + residual thrust SHP + kp	Rev. speed of compressor shaft r.p.m.	Equivalent power EHP	Specific fuel consumption kg/EHP/hr	Remarks
FRN															
Turboméca	Artouste III		1 A+1 R	0	3	1.72	0.45 (0.56)	187	5.1 : 1	4	600	—	—	0.33	Continental producing *Artouste I* under licence
Turboméca	Astazou		1 A+1 R	0	2	1.75	0.46	110	—	—	320 + 40	—	355	0.33	
Turboméca	Bastan		1 A+1 R	0	2/3	1.55	0.55	180	—	—	750 —	33 000	—	0.33	Projected for *Fonceur*, etc.
GBR															
Armstrong Siddeley	Mamba ASM.6		11 A	0	3	2.50	0.74 (0.84)	432	6 : 1	∼10	1 650 + 145	15 000	1 770	0.31	
Armstrong Siddeley	Double Mamba ASMD.3		2×10 A	0	2×3	2.50	Width 1.34 (1.12)	1 000	5.3 : 1	2×8.4	2 740 + 350	15 000	3 035	0.32	Composed of two *Mamba 5s*
Bristo	Proteus 755		12 A+1 R	8 sep. FL	2 HP 2 LP (S)	2.76	1.01	1 360	7.2 : 1	21.5	3 650 + 553	12 000	4 120	0.27	
Bristol	Orion BOn.2		7 A-LP 5 A-HP	0 10 FL	1 HP 3 LP (S)	2.85	1.06	1 430	∼10 : 1	37	4 400 + 885	10 000	5 150	0.29	Specific fuel consumption at cruising power of 3,300 EHP and at 11,000 m roughly 0.18 kg/EHP/hr
Napier	Eland NEl.6		10 A	6 sep. FL	3	3.05	0.91	785	7 : 1	14	3 150 + 410	12 500	3 500	0.27	
Rolls-Royce	Tyne RTy.2		A-LP A-HP	0 FL	1 HP 3 LP (S)	2.54	1.03	∼900	13 : 1	∼25	4 810 + 600	15 250	5 315	—	Specific fuel consumption at cruising power of 2,200 EHP and at 9,000 m roughly 0.18 kg/EHP/hr
Rolls-Royce	Dart RDa.7		2 R	7 sep. FL	3	2.49	0.97	545	5.7 : 1	10	1 800 + 220	15 000	1 990	0.26	
SOV															
State Aircraft Engine Industry	Kusnetzov NK-4		A	0	—	∼4.50	∼1.10	∼1 400	—	∼25	∼4 000 + 600	7 650	∼4 500	0.25	Development of the Jumo 022
	Ivchenko ?		A	0	—	—	—	—	—	—	—	—	—	—	Apparently development of the NK-4
	Kusnetzov " K "		14 A	0 12 B	5	6.00	1.15	2 300	13 : 1	62	12 000+1 200	8 250	13 000	0.26	
USA															
Allison	Model 501-D13		14 A	0 6 FL	4	3.71	0.68 (0.91)	795	9.2 : 1	17.7	3 460 + 330	13 820	3 750	0.24	501-D15 with 4,000 HP shaft power in production; military version T56
Allison	Model 550		A-LP A-HP	0	HP LP	∼3.80	∼0.70	∼875	—	—	— —	—	5 000 +	—	Specific fuel consumption at cruising power roughly 0.175 kg/EHP/hr
General Electric	T64		A	0	HP LP (S)	—	—	450	11 : 1	—	2 600 —	—	—	—	Available as helicopter engine with same compressor-turbine portion
Lycoming	T55-L-1		5 A+1 R	0 12 B	1 HP 1 LP (S)	1.50	0.61	315	—	—	1 500 + 172	—	1 650	0.30	LTC4B version for helicopters
Pratt & Whitney	T34		13 A	8 8 FL	3	4.00	0.86	1 210	6.7 : 1	30.5	5 500 + 560	11 000	6 000	0.29	

C — TURBINES FOR ROTARY WING AIRCRAFT

Manufacturer	Type designation	Layout	Compressor Stages	Combustion Chamber	Turbine Stages	Length m	Max ∅ (Height) m	Dry weight kg	Compression ratio	Air mass flow kg/sec	Shaft power + residual thrust SHP + kp	Rev. speed of compressor shaft r.p.m.	Equivalent power EHP	Specific fuel consumption kg/EHP/hr	Remarks
FRN															
Turboméca	Artouste II		1 A+1 R	0	2	1.70	—	110	3.6 : 1	3.2	400 —	34 000	—	—	Blackburn producing under licence as auxiliary power unit
Turboméca	Turmo III		1 A+1 R	0	2 HP 1 LP(S)	1.67	Width 0.75	205	∼5 : 1	4.8	800 —	34 500	—	0.35	Blackburn producing *Turmo I* under licence
GBR															
Napier	Eland NEl.3		10 A+9-stage auxiliary compressor	6 sep. FL	3	4.03	1.02	1 065	7 : 1	14	2 800 + 227	12 500	3 000	0.30	Auxiliary compressor to supply compressed air to rotor-blade nozzles. Propellant unit for Fairey *Rotodyne*
Napier	Gazelle NGa.13		11 A	6 FL	2 HP 1 LP(S)	1.78	0.85	392	—	—	1 800 —	20 400	—	0.30	Can be fitted in any position
USA															
General Electric	T58		10 A	0 16 B	2 HP 1 LP(S)	1.40	0.41 (0.69)	148	—	—	1 050 —	19 500	—	0.30	
Lycoming	T53		5 A+1 R	0 12 B	1 HP 1 LP(S)	1.20	0.59	208	6 : 1	4.9	825 + 46	21 500	865	0.30	Also available as propeller turbine

D — TURBO GAS GENERATORS

Manufacturer	Type designation	Structure: Layout	Structure: Compressor Stages	Structure: Combustion Chamber	Structure: Turbine Stages	Main Dimensions: Length m	Main Dimensions: Max ⌀ (Height) m	Dry weight kg	Compression ratio	Air mass flow kg/sec	Air delivery or gas hp (Pressure)	Rev. speed of compressor shaft r.p.m.	Equivalent power EHP	Specific fuel consumption kg/EHP/hr	Remarks
FRN															
Turboméca	Autan II		1 A+1 R	0	1	1.25	0.45	118	5.1 : 1	—	1.35 kg/sec (5.3 atm)	34 500	—	—	
Turboméca	Palouste IV		1 R	0	2	1.33	0.55	90	3.7 : 1	—	1.14 kg/sec (2.9 atm)	34 000	—	—	Licence production by Blackburn
Turboméca	Tramontane		1 R	0	2	∼1.40	0.58	170	3.7 : 1	7.6	2.5 kg/sec (3.5 atm)	22 600	—	—	
GBR															
Blackburn	Palouste 500		1 R	0	2	0.83	0.45	91	3.7 : 1	—	1.24 kg/sec (2.9 atm)	∼34 000	—	—	Licence version of Turboméca *Palouste*
Napier	Oryx NOr.5		12 A+ 4-stage auxiliary compressor	5 sep. FL	2	2.12	0.49	227	6.1 : 1	6.9	950 Gas-HP (1.7 atm)	22 600	—	0.28	NOr.10 improved version with 1,250 gas HP

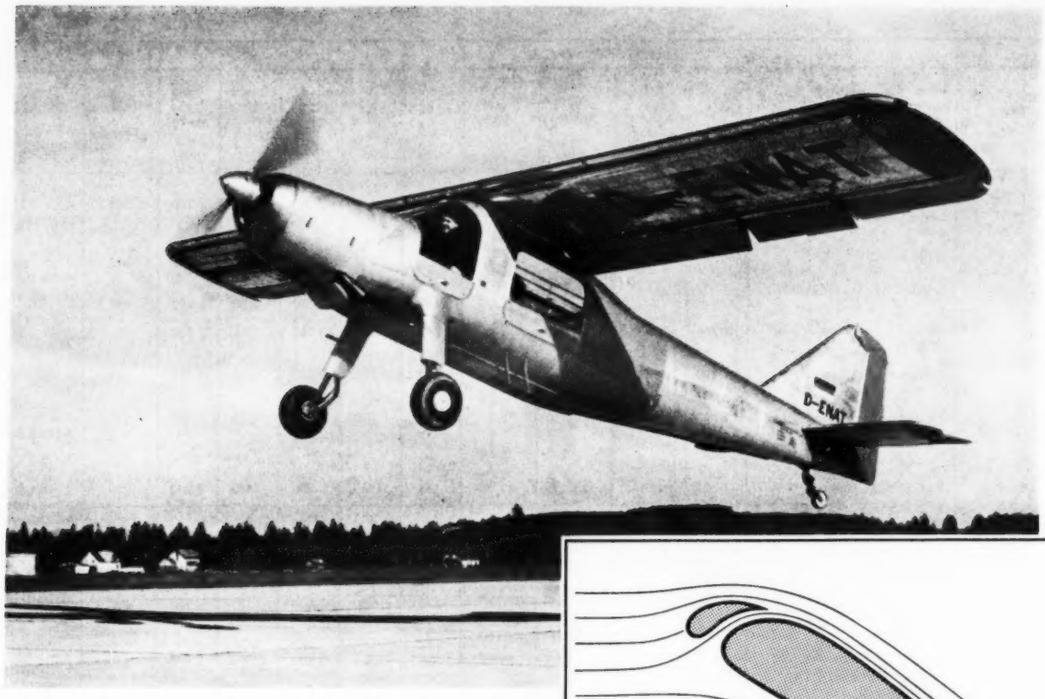
E — ROCKET ENGINES

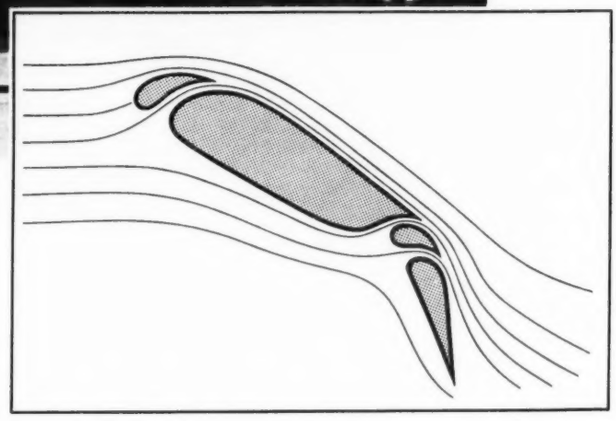
Manufacturer	Type designation	Layout	Main dimensions: Length m	Main dimensions: Circumference m	Main dimensions: Dry weight kg	Propellants: Fuel	Propellants: Oxidizer	Total sea level thrust kp	Specific propellant consumption at sea level kg/tonne/sec	Remarks
FRN										
SEPR	Type 481	3 K; Turbo-pump feed	—	—	230	Furaline	Nitric acid	4 500	—	For *Trident I.*
SEPR	Type 65	1 K; Turbo-pump feed	—	—	70	Furaline	Nitric acid	712	—	For *Durandal.*
SEPR	Type 66	1 K; Turbo-pump feed Electric starter	2.80	0.60 Width	140 Installed weight	Furaline	Nitric acid	750-1 500	5.25	For *Mirage I* and *Mystère IV*; propellant mixture ratio: oxidizer 70%, fuel 30%.
SEPR		2 K; Turbo-pump feed	∼2.80	—	—	Furaline	Nitric acid	750-1 500	—	
SEPR		2 K; Turbo-pump feed	∼2.80	—	—	Furaline	Nitric acid	1 500-3 000	—	
GBR										
Armstrong Siddeley	Screamer	1 K; Turbo-pump feed	1.98	0.68	213	Paraffin	Liquid oxygen	∼3 630	4.62	Water is injected to cool the combustion chamber; oxidizer 60%, paraffin 23%, water 17%.
De Havilland	Super Sprite	1 K; Turbo-pump feed	2.90	0.51	280	Kerosene	Hydrogen peroxide	1 900 for 40/sec	—	Weight with integral propellant tanks full 660 kg.
De Havilland	Spectre	1 K; Turbo-pump feed	—	—	—	Kerosene	Hydrogen peroxide	∼3 600	—	
Napier	Scorpion	1 K; Turbo-pump feed	0.79	0.46	—	Kerosene	Hydrogen peroxide	∼1 800	—	
USA										
Aerojet-General	LR 45-AJ-1	2 K; Turbo-pump feed	—	—	—	JP-4	Nitric acid	4 100	—	Take-off aid.
Curtiss-Wright	LR 25-W-1	2 K; Turbo-pump feed	—	—	—	—		Main chamber 3 630 Auxiliary chamber: 1 815	—	Control by continuous power lever.
Reaction Motors	LR 8-RM-6 (6000 C4)	4 K; Pressure gas feed	1.42	0.48	100	Ethyl alcohol	Liquid oxygen	2 725	5.20	

F — PISTON ENGINES

Manufacturer	Type Designation	Design	No. of cyls.	Main dimensions: Length mm	Main dimensions: Width x Height or ⌀ mm	Main dimensions: Bore x Stroke mm	Main dimensions: Swept volume lit.	Dry weight kg	Power: Take-off rating cv or hp	Power: Rev. speed r.p.m.	Power: Max. continuous rating cv or hp	Power: Rev. speed r.p.m.	Specific fuel consumption gr/cv/hr or gr/hp/hr	Remarks
CSR														
Omnipol/Praga	Doris B	Straight six	6	1 229	934 × 611	115 × 115	7.176	198 ± 2%	220	3 000	180	2 800	210	Particularly simple design; operates reliably at ambient temperatures of ± 40°C. Meets I.C.A.O. recommendations.
Omnipol/Praga	M.332	In-line inverted cylinders	4	1 102	425 × 628	105 × 115	3.98	102	140	2 700	95	2 400	195	For trainers and sports aircraft; available in 1958.
Omnipol/Walter	Minor 6-III	In-line, inverted cylinders	6	1 250	445 × 639	105 × 115	5.97	127	160	2 500	125	2 300	225	Fitted in Zlin Z.226 *Trener.*
DEU														
Porsche	Type 678/1	Straight four	4	—	—	82.5 × 74	1.582	87	65	4 500	55	4 080	222	Derived from Porsche air-cooled automobile engine; Porsche engines now also projected for *Gyrodyne* helicopters.
FRN														
Potez	6D02	In-line, inverted cylinders	6	1 554	530 × 669	125 × 120	8.83	229	240	2 530	180	2 300	220	Also 305 CV 6D30 with supercharger; also 240 CV 4D30 4-cylinder engine.

Manufacturer	Type Designation	Design	No. of cyls.	Main dimensions				Dry weight	Power				Specific fuel consumption gr/cv/hr or gr/hp/hr	Remarks
				Length	Width x Height	Bore x Stroke	Swept volume		Take-off rating	Rev. speed	Max. continuous rating	Rev. speed		
				mm	or ⌀ mm	mm	lit.	kg	hp	r.p.m.	hp	r.p.m.		
Potez	8D30	In-line, inverted cylinders, supercharger	8	1 620	795 × 802	125 × 120	11.7	335	520	2 650	360	2 450	225	Also 8D32 to drive pusher propeller (in Potez 75).
Salmson	9NH02	Radial	9	—	—	100 × 140	9.9	170	220	2 250	185	2 130	245	Also suitable for helicopters.
Salmson	SAS-04-A	λ engine	8	—	—	120 × 140	12.66	260	260	2 000	230	1 930	245	—
SNECMA-Régnier	4L00	In-line, inverted cylinders	4	1 366	500 × 760	120 × 140	6.33	155	147	2 340	135	2 280	—	Also 4L02, 4L04, 4L06, 4L08, etc.
SNECMA-Renault	12S02	λ engine, air-cooled, blower	12	1 900	700 × 990	105 × 115	12.0	∼370	580	3 300	440	3 250	225	Several thousand 12S built.
SNECMA (Bristol)	Hercules 758	Two-row radial, supercharger	14	1 600	1 320	146 × 165	38.7	∼970	2 070	2 800	1 695	2 500	∼190	For Nord 2501 transport; Bristol licence.
GBR														
Alvis	Leonides 503/4	Radial with supercharger	9	1 382	1 054	122 × 112	11.78	∼360	545	3 000	460	2 900	∼230	Numerous versions for fixed and rotary wing aircraft.
Alvis	Leonides Major 702/1	2-row radial and supercharger	14	1 575	988	122 × 112	18.3	545	885	3 000	735	2 900	∼250	Available in versions for fixed or rotary wing aircraft.
Blackburn & General Aircraft	Cirrus Bombardier 702	In-line, inverted cylinders	4	1 152	480 × 785	122 × 140	6.52	172	180	2 600	158	2 300	220	100 hp Cirrus *Minor 2A* and 158 hp Cirrus *Major 3*.
Bristol	Centaurus 373	2-row radial, supercharger, direct fuel injection	18	1 895	1 405	146 × 178	53.6	1 583	3 220	2 800	2 590	2 600	190	Still in production for Blackburn & General Aircraft *Beverley* transport.
De Havilland	Gipsy Major 200	In-line, inverted cylinders	4	1 295	426 × 758	120 × 150	6.8	182	200	2 600	185/190	2 500	240	*Gipsy Major 215* for Saro *Skeeter* helicopter.
De Havilland	Gipsy Queen 70 Mk.2	In-line, inverted cylinders, supercharger	6	1 820	497 × 844	120 × 150	10.2	310	380	3 000	355	2 700	210	250 hp *Gipsy Queen 30 Mk. 2*, 340 hp *Gipsy Queen 70-4*.
ITL														
Meccanica Verghera Agusta	G.A.40	Straight two	2	—	—	—	—	39	42	2 700	—	—	—	—
	G.A.70/0 and 70/V	Straight four	4	—	—	—	—	68/67	72	3 100	—	—	—	G.A. 70/V for helicopters.
POL														
Motoimport/ Narkiewicz	WN-3	Radial	7	885	1 106	135 × 134	13.4	240	340	2 500	285	2 250	215	In production for TS-8 *Bies* trainer; WN-4 for helicopters.
SOV														
State Aircraft Engine Industry	ASH.21	Radial and supercharger	7	1 250	1 260	155 × 155	20.5	480	760	2 400	630	2 300	—	—
	ASH.82	2-row radial and supercharger	14	2 100	1 260	155 × 155	41	∼900	1 850	2 500	1 500	2 300	—	2-row radial version of the ASH.21.
	ASH.90	2-row radial and supercharger	18	1 950	1 430	155 × 160	54.9	∼1 350	2 500	2 800	2 000	2 600	210	—
SPN														
ENMASA-Empresa Nacional de Motores de Aviación	Tigre G-IV-A	In-line, inverted cylinders	4	∼1 130	400 × 760	120 × 140	6.3	135	130	2 100	100	1 850	225	Also *Tigre G-IV-B* of 160 cv/2,300 r.p.m. and *Tigre G-IV-B5*.
	Flecha F-IV-1	Straight four	4	809	804 × 628	105 × 100	3.5	∼100	95/90	2 500	70	2 300	210	—
	Alcion A-1	Radial, supercharger	7	1 166	850	110 × 110	7.32	∼225	275	3 000	250	2 800	210	In versions for fixed and rotary wing aircraft.
	Sirio S-3	Radial, supercharger	7	1 127	1 120	150 × 145	17.9	∼330	500	2 300	∼380	2 000	—	Sirio S-3 made first bench runs in June 1957.
USA														
Aircooled (Franklin)	6V4 (0-335)	Straight six	6	1 036	800 × 850	114 × 89	5.5	∼140	178	3 000	134	2 600	230	In versions for fixed and rotary wing aircraft (6V4-200, 200 hp/3,100 r.p.m.).
	6V6 (0-425)	Straight six	6	∼1 000	845 × 970	120 × 102	6.9	160	245	3 275	170	2 950	230	0-425-2 with supercharger delivers 300 hp on take-off; also 0-425-B with turbo supercharger.
Continental	GS0-526-A	Straight six with supercharger	6	1 340	915 × 610	130 × 108	8.64	245	320	3 000	220	2 700	∼230	In addition to well-known 85 hp C-85 and 90 hp C-90, also 0-300 (145 hp), 0-470 (230 hp), S0-470 (265 hp) and FS0-470 (260 hp).
Lycoming	GS0-580-D (0-580-1)	Straight eight with supercharger	8	∼1 440	840 × 870	124 × 99	9.4	277	400	3 300	350	3 000	∼210	Numerous 4, 6 and 8-cylinder models in the 115 to 400 hp power class.
Pratt & Whitney	R-2800-CB. 16 Double Wasp	2-row radial and supercharger	18	∼2 070	∼1 340	146 × 152	45.9	1 080	2 400	2 800	1 800	2 600	190	R-2800 fitted e.g. in CV-440, DC-6 series, Fairchild C-123, Sikorsky S-56 helicopter, etc.
Wright	R-3350 Turbo-Compound TC18 EA1	2-row radial and supercharger	18	2 332	1 437	155 × 160	54.9	1 650	3 400	2 900	2 450	2 600	170	Also R-3350-30 WA (3,500 hp at 2,400 r.p.m.) and R-3350-32 W (3,700 hp at 2,900 r.p.m.); both are military engines.





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  Large useful space and easy access to cabin through four adequately-sized doors, with optimum visibility conditions
  Rugged structure and simple maintenance of airframe and engine

- **A high lift coefficient gives the Do 27 the flying qualities of a typical short take-off aircraft. The aerodynamic system of circulation control designed for this end consists of a fixed leading edge slat in conjunction with a double slotted flap. With this arrangement the stalling speed is 30 knots and the max. speed 135 knots, which corresponds to a speed ratio of more than 1 : 4.**

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Since 1949 Ferranti have been collaborating with Bristol Aircraft Limited in the development of guided weapons for the air defence of Great Britain. The outcome is the "Bloodhound", a surface-to-air guided missile which, together with early warning information from long-range tactical control radar stations, forms a complete defence system. It is now the mainstay of Britain's Air Defence.
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F
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World's first supercharged turboprop

First and only turbine engine to deliver full take-off shaft horsepower at all temperatures, at all elevations up to 15,000 feet.

The Bristol Orion is an advanced concept, opening up new possibilities of versatile, low-operating-cost transport.

When the Bristol designers created the Orion, they successfully met these three demands—

1. **Sea-level take-off power at any airfield in the world.**
2. **Specific consumption superior to the leanest existing engines.**
3. **The highest possible power-to-weight ratio in cruising flight.**

FACTS ON THE NEW ORION

A two-spool constant-power turboprop. Take-off rating, 5,150 ehp.

Orion's twin compressors. Work split between low and high-pressure stages is arranged to allow both stages to run near maximum adiabatic efficiency. The twin-spool layout also leads to unrivalled flexibility of operation.

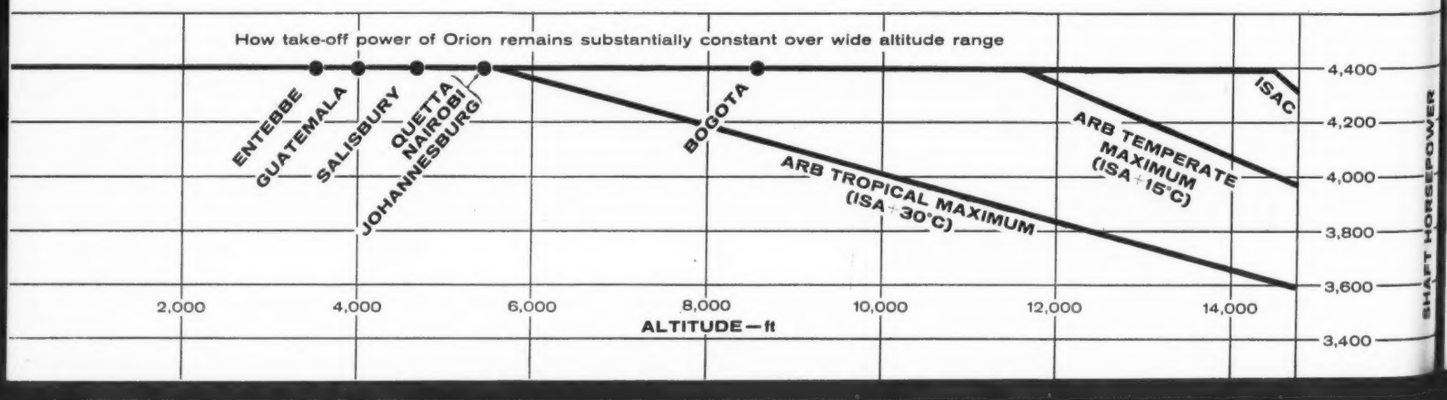
Advantages of "gating". Orion is an 8,000-horsepower engine deliberately throttled at sea-level. At 30,000 feet and maximum cruising power it delivers 3,960 ehp. By restricting output to 5,000 ehp from sea-level up to 15,000 ft, propeller and reduction gear can be lightened—giving marked reduction in specific weight.

Yet for take-off at high temperatures or elevations the Orion can be given its head by simply opening the throttle.

Phenomenal economy. Specific fuel consumption of the Orion is well under 0.40 lb/ehp/hr. This phenomenal economy makes it possible to achieve long-range, ultra-low-cost transport of large payloads.

Orion-powered airliners will be able to operate in the region of 550 mph—thus achieving very high block-speeds at a lower operating cost than ever before.

BRISTOL
Aero-Engines



Motive Power for Half the World . . .
United Aircraft Corporation

"I need hardly repeat to a Pratt & Whitney group that our first product, the Wasp engine, almost immediately made aviation history in both military types of airplanes and in commercial air transport which latter was just emerging in the late twenties. To accomplish this purpose our engine had to be better than its competitors and we had to prove this in the air. When this objective was met, it naturally followed that our foundation was laid and our company was firmly entrenched in its chosen field."

The theme of the following article could scarcely be more clearly outlined than in the above words spoken by the late *Frederick B. Rentschler,* founder of United Aircraft Corporation, to his staff in 1950, at Pratt & Whitney's 25th anniversary celebrations. Fundamentally, both Rentschler's life story and his organization's history can be epitomized in the expression "*motive power*".

Of the three production divisions of United Aircraft Corporation—Pratt & Whitney Aircraft (engines), Hamilton Standard (propellers and equipment), Sikorsky Aircraft (helicopters)—Pratt & Whitney is by far the most important. It accounted for roughly 72% of United's 1956 sales. It employs 40,000 persons out of the Corporation's total labour force of 60,000. And 90% of the coming jet aircraft for long-range operations, the Douglas DC-8s and Boeing 707s, will be equipped with P & W engines. Without in any way under-estimating the achievements of the other divisions, it is therefore quite legitimate to give Pratt & Whitney first place in any assessment of United Aircraft Corporation's success.

Boomerang transactions between Europe and U.S.A.

Rentschler's first training material, as an engine manufacturer, was a European engine. When the United States entered World War I, the American Government made the sad discovery that America had neither a suitable aircraft engine nor adequately trained engineers who could be placed in charge of an aircraft engine manufacturing plant. Finally, a staff officer in Washington remembered a young engineer, the son of a foundry owner in Hamilton, Ohio, who spent all his spare time avidly studying light engines. Commissioned in the Army, Rentschler was assigned to the "Production Section" of the embryo Air Corps and sent to the Wright-Martin plant at New Brunswick, New Jersey, to produce an Americanized version of the internationally known French Hispano Suiza engine.

However, Rentschler was not the man to be satisfied with building somebody else's engine. His objective was an American-designed engine . . . When the War was over and he was back in civilian clothes, he did not return to his father's plants, but founded the Wright Aeronautical Corporation and laid the foundations for the production of the *Whirlwind* engines which a few years later crossed the Atlantic in Lindbergh's "Spirit of St. Louis", Chamberlin's "Bellanca" and other American and European aircraft.

By this time, however, Rentschler had left the Wright Aeronautical Corporation to form, with a small group of associates, the *Pratt & Whitney Aircraft Company* in East Hartford, Connecticut, in the heart of New England. In the spring of 1925 the U.S. Navy had announced that it wanted an efficient air-cooled engine of 400 h.p., weighing not more than 600 lbs. and reliable enough for long flights over water. At that time there was no such engine in existence. Rentschler managed to raise $250,000, leased a tobacco warehouse, acquired the necessary tooling and set to work, with George J. Mead, his Chief Engineer. By December 1925 the first *Wasp* engine was running on the test bed.

The Navy was not his only customer. William E. Boeing, an aircraft manufacturer—whose name today needs no introduction, but who in those days was, like Rentschler, just earning his spurs—had in 1928 put in the lowest bid for the operation of an air service between San Francisco and Chicago. The Boeing Company fitted 24 Pratt & Whitney engines in its aircraft, with which it made the first real start towards a transcontinental passenger air service. And in October 1928 Pratt & Whitney Aircraft Company joined in a merger with Boeing and Boeing Air Lines to form *United Aircraft and Transport Corporation.* This operation continued until 1934, when the Corporation had to be dissolved under new legislation requiring that transport and manufacturing companies be split. Out of this dissolution emerged three companies whose names are today household words in the United States: Boeing Airplane Company, United Air Lines and United Aircraft Corporation.

Frederick B. Rentschler, who was Chairman of the Board of United Aircraft Corporation from its initial foundation in 1925 until his death on April 25th, 1956.

H. M. Horner, 52, who took over the Board Chairmanship after Rentschler's death, had been President since 1943. Horner joined Pratt & Whitney in 1926, when the first *Wasp* engine went into production.

Leonard S. Hobbs, 59, Vice Chairman of United Aircraft Corporation, joined Pratt & Whitney Aircraft in 1927 as a research engineer and has been associated with many of the division's advanced engine developments. He was awarded the 1953 Collier Trophy for his design of the J 57.

William P. Gwinn, 48, President of United Aircraft Corporation, spent all his free time as a boy visiting Long Island Airport and was engaged at Pratt & Whitney Aircraft as a stock clerk at the age of 19. Gwinn had been General Manager of Pratt & Whitney Aircraft since late 1943.

Joseph M. Barr, President, United Aircraft Export Corporation.

James S. Lee, Executive Vice President, United Aircraft Export Corporation.

During the two decades that had passed since Rentschler had been posted to the Air Corps, his early study of the Hispano Suiza engine had borne rich fruits. The *Wasp* had been succeeded by the *Twin Wasp* and *Twin Wasp Junior* two-row radial engines. American engine manufacturers had caught up with the European lead, perhaps even outpaced it. And in 1938—39 when war clouds were gathering over the skies of Europe, United Aircraft received substantial European orders for Pratt & Whitney engines, and the first "boomerang transaction" between Europe and the United States got underway. Europe was repaid with interest for the "training material" which it supplied in the form of the Hispano Suiza engine of World War I. During World War II Pratt & Whitney delivered 350,000 aircraft engines and thus supplied the power for a good half of all American and some of Europe's combat aircraft.

The second boomerang transaction came a few years later. To meet the wartime demand for piston engines, United Aircraft had had to lay aside the work it had begun on turbine engines. Meanwhile Britain had successfully continued development of Sir Frank Whittle's jet engine and had produced the Rolls-Royce *Nene*, which had aroused world interest and admiration.

Instead of resigning itself to the situation, United Aircraft in 1947 sent Pratt & Whitney General Manager William P. Gwinn to Derby, where he concluded a comprehensive agreement on technical cooperation with Rolls-Royce. The production rights, workshop drawings, handbooks and test instructions for the Rolls-Royce *Tay*, which then crossed the Atlantic, laid the foundations for American jet engine manufacture of today.

The Pratt & Whitney J57 engine (10,000 lbs. thrust class), of which more than 9,500 have been produced in the past four years, equips not only the U.S.A.F.'s and Navy's fastest fighters and fighter-bombers (F-100, F-101, F-102, F4D, F8U, A3D), but also the B-52 intercontinental bomber, the KC-135 jet tanker and the SM-62 *Snark* long-range guided missile. But this is not all . . . Installed in the coming generation of Douglas DC-8 and Boeing 707 long-range jet airliners, the J57 and its more powerful successor, the J75 of 15,000 lbs. thrust, will complete the circle opened by the *Tay* licence. American is returning a hundredfold what it received from Europe.[1]

The other divisions

Nor have the other divisions of United Aircraft Corporation any reason to be ashamed of their achievements. *Hamilton Standard*, of Windsor Locks, Connecticut, today employs more than 10,000 workers, and its propellers equip roughly 90% of all piston-engine aircraft in service. The Turbo-Hydromatic propeller is capturing an increasingly large market in the field of propeller turbine power.

[1] To complete the picture, it should be stressed that large-scale production of powerful piston engines is continuing (for example, the R-2880 for the Convair-Liner, the DC-6 series and the Fairchild C-123 transport); in addition, the T34 propeller turbine is projected for the Douglas C-133A transport. Other jet engines in the project or development stage include the J 52, J 58 and J 91. Furthest advanced is the J 52, in the 7,500 lbs. thrust class, which is to be fitted not only in military aircraft but also in future medium-stage airliners.

Pratt & Whitney's main plant at East Hartford, Connecticut.

Finally, the growing production of equipment – hydraulic, pneumatic and electronic equipment, turbine starters, fuel regulators, air conditioning systems, etc. – should not he overlooked; many of these items are also produced under licence outside the United States, for example by de Havilland Propellers Ltd. and Plessey Company Limited of Britain, Fiat of Italy, Ratier-Figeac of France and Sumitomo Metal Industries Limited of Japan.

*

Sikorsky Aircraft, of Stratford, Connecticut, bears the name of the man whose work fills an impressive chapter in the history of flying: Igor Ivan Sikorsky, the great Russian-American designer and pilot, who built and flew the first four-engine aircraft, built the first "Clipper" flying boat, set up countless records, and – of greatest interest in the present connection – developed the first American helicopter, the VS-300, with which he achieved a world endurance record in May 1941.

Sikorsky Aircraft's payroll today numbers 10,500 persons, and its military and civil helicopters (Sikorsky S-51, S-55, S-56, S-58) are in operation throughout the world and are so well known to readers that no lengthy descriptions are required here.

*

Finally, there is another division which must on no account be overlooked, as it is, so to speak, the "heart of the overseas business". According to the 1956 annual report, *United Aircraft Export Corporation* last year achieved the best results in its history. Special stress is laid on the growing export business in helicopters, which went to France, Belgium, Britain, Denmark, South Africa, Israel and Thailand. Exports of piston engines, propellers and spare parts developed along similarly satisfactory lines.

The founder's legacy

In April 1956 death deprived United Aircraft Corporation of its founder and chairman Frederick Brant Rentschler. But if he could come back and read the 1956 report or the figures for the first half year of 1957, he would be satisfied with the work of the successors whom he himself trained and placed in the saddle. These documents, signed by the new Board Chairman H. M. Horner and by President William P. Gwinn, leave no room for doubt as regards the sound management of United Aircraft. And the results speak for themselves. To mention only a few figures for the first half of 1957, net profit amounted to $25,700,000 ($4.80 per share), compared with $20,500,000 ($4.06 per share) in the first half of 1956; total sales were $604,000,000 compared with $458,000,000 the previous year. Order backlog on June 30th, 1957, was $2,050,000,000 ($2,100,000,000 on June 30th, 1956).

Perhaps the greatest asset which Rentschler left behind, however, was his staff of colleagues, many of whom had been with him since his early days in East Hartford.

The following brief summary of the most important operating results illustrates the Corporation's growth during the past decade.

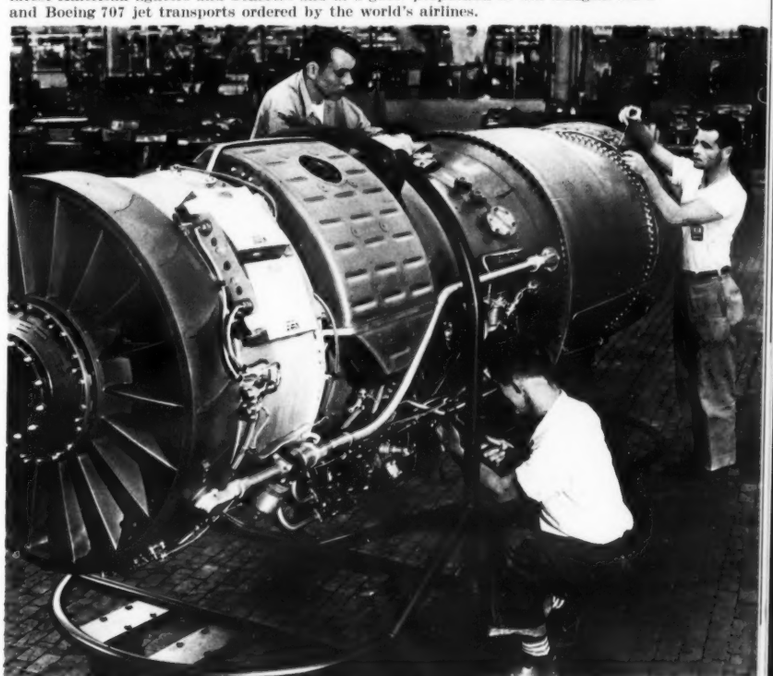
United Aircraft Corporation operating results 1946-1957 *

	Sales ($ m)	Net Profit ($ m)	Profit per Share ($)	Dividends ($)
1946	120.6	6.06	0.99	0.55
1947	208.5	9.82	1.79	0.69
1948	208.3	9.43	1.70	1.11
1949	227.3	10.09	1.94	1.11
1950	269.6	13.20	2.49	1.11
1951	417.5	14.27	2.71	1.33
1952	668.1	17.81	3.45	1.33
1953	691.1	21.19	4.15	1.83
1954	655.0	26.00	5.11	2.33
1955	698.9	31.06	6.14	2.75
1956	954.3	37.08	7.06	3.00
first half year 1957	604.0	25.74	4.80	1.50

* The dollar values for net profit per share and for dividends have been adjusted to changes in capital which have taken place in the meantime: a stock split in the ratio 3 : 2 in September, 1955; distribution of a 20 % stock dividend in May 1951. – Allowance has also been made for the splitting off of the Chance Vought division, of Dallas, Texas, on July 1st, 1954, and its establishment as an independent company with the name of Chance Vought Aircraft Inc.; in this reorganization 1 ½ Chance Vought shares were issued for every 4 ½ United shares held.

A Sikorsky Aircraft helicopter parade. Top to bottom: the twin-engine S-56, which was developed for the U.S. Marine Corps, but is also destined for the other Services and for the civilian market; the S-58, in operation with the U.S. Army, U.S. Navy, Marine Corps and a number of American and European air transport operators; the eight-seat S-55, one of the most widely used rotary-wing aircraft.

The Pratt & Whitney J 75 jet (15,000 lbs. thrust class) will be fitted in many of the latest American fighters and bombers and in a good proportion of the Douglas DC-8 and Boeing 707 jet transports ordered by the world's airlines.



Bridgehead in Space

By Otto C. Winzen,

President of Winzen Research Inc., Minneapolis

Otto C. Winzen, the author and director of the research, design, construction, testing and flight operations for *Project Man-High*, says his final goodbye to Major Simons. Time: 0922 hrs CDT, August 19th, 1957. Location: Crosby, Minnesota.

The flight of manned rocket ships into space may still be a good many years in the future, but the development of the sealed space cabin and the study of the human factors of space flight took a giant step forward with the successful completion of the first two flights on Project MAN-HIGH of the U.S. Air Force and Winzen Research Inc. (a manned satellite). That this should happen in 1957, the 10th anniversary year of the plastic stratosphere balloon, is a matter of personal pride and satisfaction, as is the fact that these balloon expeditions to new record altitudes and duration were, for the first time in history, carried out entirely by a single organization. Winzen Research Inc. was responsible for the research, design, construction, testing and flight operations for Project MAN-HIGH.

The balloon pilot . . .

Major *David Simons,* who was also the Air Force Project Officer, became the first man in history to see the sun set and then rise again from the edge of space. His 32-hour flight of August 19th—20th reached above 100,000 feet altitude, approximately 30 kilometers. He was eminently qualified to make the first major scientific flight of the MAN-HIGH programme following Captain Kittinger's successful test flight of June 2nd in the same gondola. Major Simons is a flight surgeon, was trained as a balloon pilot in Winzen open "Sky-Car" balloon flights, took a parachute jump, and is a scientist in his own right. He is Chief of the Space Biology Branch of already famous Colonel Stapp's Aero-Medical Field Laboratory, Holloman Air Force Base, New Mexico.

. . . and his balloon

The gondola is fabricated from aluminum and has a cast heat-treated aluminum turret as a central ring in which all stresses are concentrated. The internal structure as well as the parachute suspension terminates at this rigid turret, which also contains the 6-inch diameter portholes. A top and bottom shell are added by removable clamps at the turret, and these shells can be opened at will by the pilot. The gondola, completely equipped with flight instruments including altimeters, pressure gauges, thermometers, and instruments indicating the external and internal climate, is suspended by a large cargo parachute, which in case of balloon failure would return it safely to earth within 25 minutes. The pilot also carried his own personal parachute. The oxygen system consisted of a 5-liter liquid oxygen converter, a 45-minute compressed oxygen supply, and a 15-minute compressed oxygen supply in the pressure suit. However, none of this emergency equipment was called upon during the flight, which proceeded generally according to plan.

The gondola developed for the manned flights was itself subjected to a series of animal flights to study its temperature control under hostile space-equivalent conditions where temperature is defined as a radiation equilibrium. The classical black and white gondolas are useful for daylight flights only. Skin temperatures of 250°F in the daytime and —60°F at nights prevail, artificial cooling being accomplished in the daytime by a heat exchanger.

Test flights also studied parachute performance, communications and, most important, the performance of the huge plastic balloon system. Two and three million cubic foot balloons were used as the MAN-HIGH flight vehicles. This second flight on August 19th—20th was made with a 200.2 foot diameter balloon of over 3,000,000 cu. ft. volume. The skin was 1.5 mil gage (.0015″) polyethylene film of special construction and excellent low-temperature flexibility. An electric valve of 14″ diameter was used at the apex, and three special appendices accomplished the spilling of gas on reaching altitude.

The capsule, in addition to the instrumentation designed to maintain the artificial oxygen-helium-nitrogen atmosphere at a 25,000 ft. equivalent pressure altitude, was crammed full of other equipment. This included HF, VHF and omni, communication and navigation gear, automatic beacons for telemetering altitude and the pilot's heart-beat and respiration, instrumentation required for establishing the official world altitude record under auspices of the Fédération Aéronautique Internationale (FAI), complete flight controls for the operation of the aerostat and controls for the automatic or manual operation of the capsule climate.

The 30-hour flight

The entire length of the balloon-capsule system was 350 ft., and as it was not possible to find a location in the central plains States of the USA where the wind conditions at that height above the surface would be sufficiently calm, a 425 ft. deep open pit iron mine near Crosby, Minnesota was chosen as the launching site.

After considerable before-dawn activity in preparation, the system was successfully launched at 0922 hours CDT on August 19th.

Major Simons ascended initially at the rate of 1,000 feet per minute and reached his ceiling altitude of 100,000 feet in two hours and 18 minutes. During the day he floated 'westward over Minnesota at about 20 miles per hour. Our tracking caravan of ground vehicles and six aircraft followed his progress. My command post was a communications van which followed the flight westward.

At sunset, Simons was over Detroit Lakes, Minnesota, and was allowed to make the decision whether or not to remain aloft overnight. In spite of some communications difficulties (his automatic radio beacon operated only inter-

Major David Simons, chief of the Space Biology Branch of U.S.A.F.'s Aero-Medical Field Laboratory, Holloman A. F. Base, New Mexico, in "Battle-Dress".

Simons carries out final checks of gondola instruments before commencing his 32-hour cruise to a record 100,000 ft. altitude.

mittently and therefore could obtain only spotty ADF fixes), Simons elected to remain aloft.

As a result of the cooling of the gas after sundown, Simons' altitude dropped to 84,000 feet during the night. The winds also slowed to about five miles per hour. During the night, a thunderstorm moved in under Simons—something completely unpredicted by the project meteorologists. By this time, the aerostat had settled to about 70,000 feet and the thunderheads were right around him, again a surprising discovery to meteorologists. To gain altitude, we decided to have him drop two of the expended fifty-pound battery packs as ballast, and he rose safely above the storm raging below.

After sunrise, the balloon again began to ascend due to the superheat of the sun and the expansion of the gas. He had reached 90,000 feet by shortly after 8.00 a.m., but was still over the thunderstorm. An hour later, he saw a break in the clouds over Aberdeen, South Dakota. But it was just a hole, and I advised him not to try a descent, because a 75-mile per hour jet stream at 55,000 feet would have carried him right back into the thunderstorm.

The flight had now progressed several hours past the planned termination point, and several problems developed. The chemicals in the air regeneration system had apparently lost some of their ability to absorb carbon dioxide from the capsule atmosphere during the long cold night. As a consequence, the amount of CO_2 in the capsule began to build up, and it was necessary for Simons to clamp on the face mask to his pressure suit and breathe pure oxygen for ten minute intervals to allow the air regenerator to remove the backed-up carbon dioxide. Since Simons' power supply was running low, it was necessary to turn off the capsule cooling system. The temperature inside the capsule went up to about 80°F which was extremely uncomfortable for Simons in his pressure suit. But it was necessary to keep him at ceiling altitude this long, while his balloon drifted westward allowing the storm to move to the east.

Finally, shortly after 2.00 p.m. Simons was able to establish a steady rate of descent, and at 5.32 p.m. on August 20th he landed his balloon-capsule system in a South Dakota field, successfully completing his MAN-HIGH flight to the edge of space.

*

During his 32 hours and 10 minutes aloft, Simons had seen and felt things never before experienced by man. He saw an auroral display to the north that had a consistent greenish glow and a very clean separation from the horizon (about 10 degrees).

Otto C. Winzen was born in 1918 in Cologne, Germany, emigrated to the United States in 1937, and studied advanced aeronautical engineering at the University of Detroit. He worked for the Firth-Sterling Steel Company, Detroit, and, during the war, was Chief Engineer with the Minnesota Tool and Manufacturing Corporation, Minneapolis; he left this organization in 1946 to propose a programme of upper atmosphere research to the Government, organizing in the same year the aeronautical laboratories at General Mills based on his proposed projects. He is responsible for the development of the plastic stratosphere balloon, for which he holds the basic patent, and many other aeronautical research projects. In 1948 he formed his own company, Winzen Research Inc., which specializes in the research, development and flight operations of plastic stratosphere balloons, and also develops the unique airborne instrumentation, including manned gondolas, for such flights. Winzen had full responsibility for the Air Force Project Man-High and also conducted the flight operations — the first time in history that one organization has had the responsibility for entire stratosphere flight expeditions. He is a member of the Institute of Aeronautical Sciences, the American Meteorological Society and the American Rocket Society, and has recently been nominated as the U.S. delegate to the Ballooning Commission of the Fédération Aéronautique Internationale.

At 3.30 a.m. he saw the first evidences of dawn —a reddish glow on the horizon with a band of greenish aquamarine blue above, and still another band of deep violet above it that faded off into the black night sky filled with stars.

Several times during the flight the horizon was clear and he distinctly saw the curvature of the earth. Shortly after reaching his ceiling altitude, Simons saw Lake Michigan in its entirety and several times during the flight saw the mountain ranges to the west. Through his 5-inch telescope the stars appeared as steady bright lights rather than twinkling and diffused as they are seen on earth.

The sun broke across the horizon at 6.05 a.m., and Simons saw a brilliant green flash of light as it came up—a phenomenon that is frequently seen in the tropics but never before seen so far north.

Breakfast for Simons consisted of a standard flight ration for extended flights consisting of ham and eggs, sliced peaches and a nut roll. During the night, he had eaten three candy bars. Other than a cheeseburger he had eaten during the ascent, this was his only food.

Major Simons' flight schedule is shown in the following table:

Launch	09:22 hrs. local time
Ceiling altitude	11:40 hrs.
Sunset	20:40 hrs.
Sunrise	06:05 hrs.
Ceiling	10:30 hrs.
Descent	15:00 hrs.
Landing	17:32 hrs.
Flight during night hours	9 hours, 25 min.
Flight during daytime hours	14 hours, 35 min.
Balloon floating at ceiling altitude	25 hours, 20 min.
Duration of entire flight	32 hours, 10 min.

Results

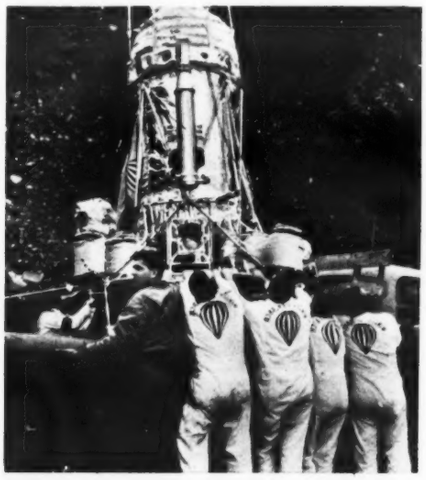
Merely to stay aloft and prove the day/night capability of the new balloon-borne research station, as well as man's ability to undertake such flights without harmful after-effects, would have been a historic achievement. But even beyond that, this last flight carried a battery of instruments for scientific observations in the field of aero-medicine, astronomics and meteorology.

There were a total of 25 experiments, including work with a 5-inch astronomical telescope with four eye pieces and articulated optically flat mirror. Major Simons carried two movie cameras and a 35-mm camera. There was also a spot photometer for measuring sky brightness. Visual impressions were recorded on a portable magnetic tape recorder for future analysis. Also included was a series of cosmic ray tests, whereby cosmic ray impacts were recorded by means of track plates taped to his arms and other track plates located in the gondola. Frequent blood samples were taken from Major Simons in order to study the effect of cosmic radiation so that he, himself, served as a human guinea pig for space-medicine studies.

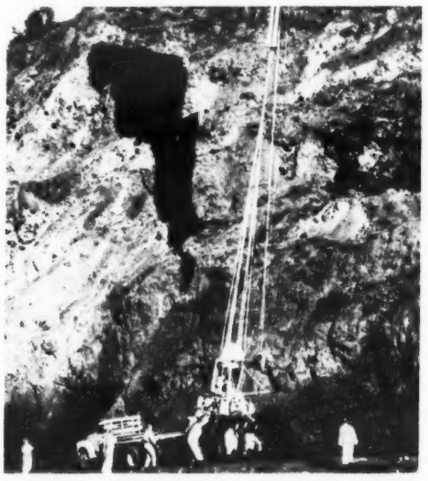
Although it will be months before all of the scientific results of the flight will become known, we feel that this second MAN-HIGH flight was completely successful. But the most important aspect of the flight was that we have established a bridgehead in space, on a plastic balloon ascent which we hope will be the forerunner of many more balloon-borne laboratory flights in a true renaissance of man's oldest aerial vehicle.

Simons, showing evidence of his ordeal, is assisted from his flight suit after the successful landing at Frederick, S. Dakota. Time: 1732 hrs CDT, August 20th, 1957.

Winzen technicians prepare to manhandle the gondola downwind prior to launching. The telescope can be seen at front, together with batteries which are parachuted as ballast. The Winzen pennant also accompanied Captain Kittinger on his earlier 96,000 ft. flight.



The actual moment of launching. The gondola is downwind and directly beneath the balloon, whose shadow can be seen against the side of the pit.



What's in the Air?

Extracts from Interavia Air Letter, *daily international news digest, in English, French and German. All rights reserved.*

● **Australian National Airways'** future has finally been decided with the directors' and shareholders' acceptance of R. M. Ansett's £ A3,300,000 offer. Ansett, who is Managing Director of Ansett Transport Industries Ltd, will take over A.N.A. and its two subsidiaries National Instruments Co. Ltd and Aviation and Engineering Supplies Ltd, together with about 40,000 shares in Butler Air Transport Ltd, New South Wales; included in the deal are also a further 80,000 shares in B.A.T. which A.N.A. directors hold under the name of Bungana Investments Ltd. Ansett thus becomes the controller of four of Australia's top domestic airlines—Australian National Airways, Ansett Airways, Butler Air Transport and Queensland Airlines (B.A.T. holds a controlling interest in Q.A.L.). The company will probably automatically enjoy the provisions of the 1952 Airlines Agreement Act for a 50 percent share in airmail contracts and re-equipment loans. Ansett has said that Ansett Airways and A.N.A. will continue present individual operations but that there will be a gradual integration, with the two companies probably finally emerging under the title of Ansett National Airways.

● **Alitalia Linee Aeree Italiane.** At Extraordinary General Meetings held on August 28th the shareholders of the two Italian airlines Linee Aeree Italiane and Alitalia ratified the decisions of the respective boards to create a single Italian Company with the title Alitalia Linee Aeree Italiane. LAI has gone into voluntary liquidation and the former Alitalia company will take over all personnel, aircraft and equipment, and will operate all LAI's former services. The Board of Directors of the new company will include nine members of the former Alitalia Board: Count Nicolo Carandini, Lord Douglas of Kirtleside, Luigi Acampora, Ercole Agosta, D. L. Craig, Antonio Sorrentino, Giovanni Pedace, Luigi d'Alessandro and General Count Umberto Baistrocchi; and six members of the former LAI Board: General Aldo Urbani, Giuseppe Zuccoli, Danico Sartago, Tuttlio Torchiani, Mario Guidi and Enrico d'Arienzo.

● **British European Airways Corp.** has ordered six de Havilland *Comet IVB* jet airliners for delivery in late 1959 and early 1960. The total value of the aircraft is £9,000,000 and they will be put into service on BEA's longer routes, particularly in the Mediterranean areas.

● **The conclusion of an agreement** modifying the previous Air Treaty between the Netherlands and Japan has been announced in Tokyo. The accord will permit KLM Royal Dutch Airlines to start a service between Amsterdam and Tokyo along the Arctic route in the autumn of 1958.

● **Northrop Aircraft Inc.** is setting up a new division to be called Nortronics which will handle the company's growing activity in the design, development and manufacture of electronic, electro-mechanical and opto-mechanical products and components. General Manager of the Nortronics Division will be Dr. William F. Balhaus, who was formerly Vice President and Chief Engineer of the Northrop Division at Hawthorne, Calif. Nortronics is the fourth division established by Northrop.

● **The Brazilian Airline Varig** has ordered three Boeing 707 Intercontinentals from Boeing Airplane Company, first deliveries of which will be made in July 1960. Cost of the aircraft, plus spare engines and parts, will approximate $20,000,000. The airliners will accommodate 110 passengers and will be used in non-stop de luxe service between New York and Rio de Janeiro.

● **North American Aviation** is to close down its Fresno, Calif. plant before the end of 1957 because of lack of work. More than 1,800 employees will be discharged in three months. The Fresno plant started operations in November 1951 and reached peak employment of 3,200 less than one year ago. Sales in nearly six years of operation totalled $75,000,000.

● **A Lockheed X-17** has begun a tour of the United States to be exhibited in various parts of the country. An estimated 15,000,000 Americans will see the giant three-stage test missile during the next several years as it journeys some 300,000 miles.

● **Italy may build U.S. guided missiles** under licence. Now that the Italian Army has taken delivery of its first *Nike* and *Honest John* missiles, the Pentagon has agreed that Italian experts should familiarize themselves with the latest American equipment. Permission has also been given to supply patents, manufacturing licences and prototypes to Italy to enable production to be started there.

● **Brigadier General Domenico Ludovico** has been appointed head of the Difesa Aerea Territoriale, Italian Air Force headquarters. He succeeds Brigadier General Franco Cavallaria who has reached retirement age.

FLYING EQUIPMENT AND POWERPLANT

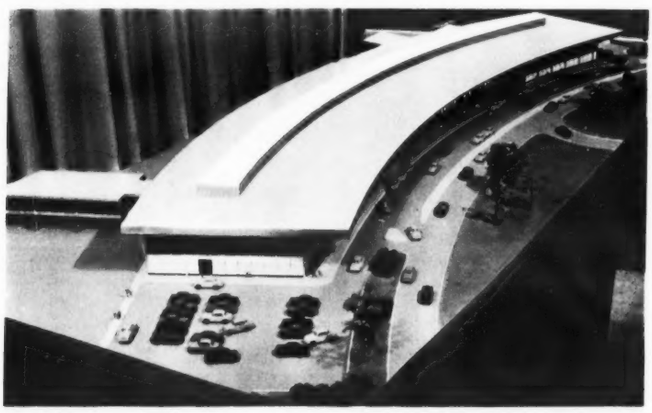
● The latest mark of *Westland Whirlwind* anti-submarine helicopter to go into service for the Royal Navy is the *HAS.7*, powered by an Alvis *Leonides Major 155* of 780 h.p.

Count Nicolo Carandini, President of Alitalia-Linee Aeree Italiane, the new unified Italian airline.

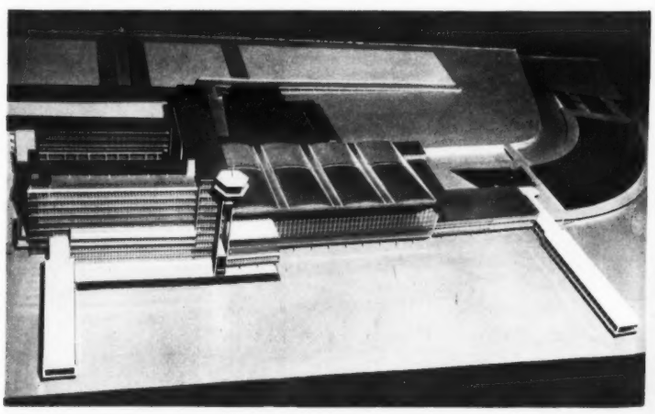
Roy E. Wendahl has been appointed Vice-President, Sales, of Hughes Aircraft Company, Culver City.

Smiths Aircraft Instruments Ltd.: G. G. Roberts (left) has succeeded E. B. Moss (retired) as Technical Director. New members of the Board are L. C. Harman (centre) and A. M. A. Majendie (right).

Model of the $ 10,000,000 passenger terminal to be constructed by United Air Lines at New York International Airport.

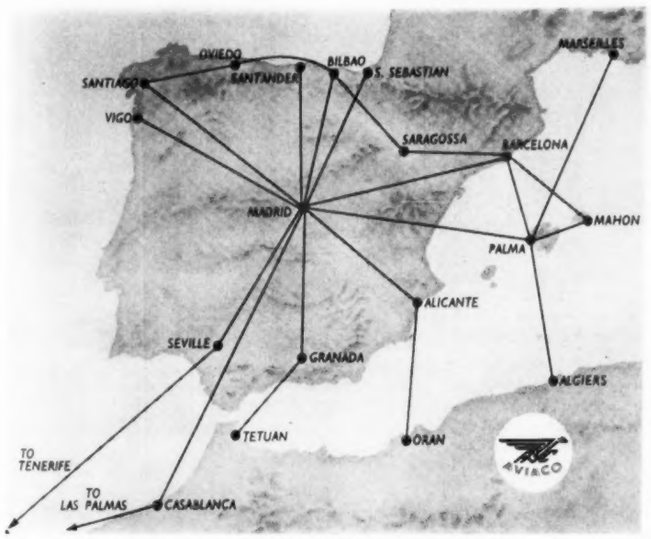


Model of the terminal building at Brussels-Melsbroek, to be opened in 1958. Sabena is responsible for supervising the building work.



Air Marshal C. Roy Slemon, Chief of the Air Staff of the Royal Canadian Air Force (left), has been appointed Deputy Commander-in-Chief of the Canada-United States Air Defence Command, Colorado Springs. He is succeeded as Chief of the Air Staff by Air Marshal Hugh L. Campbell (right). This Command, headed by Colonel Earl Partridge, U.S.A.F., will supervise training of interceptor forces, standardize procedure and conduct peace-time manœuvres.

First flight of a Kaman Aircraft Corporation pilotless helicopter: take-off, hovering, forwards, backwards and sideways flight and landing were controlled from a ground station. To meet C.A.A. requirements, the helicopter was tethered to the ground by several hundred feet of rope.



Aviaco Líneas Aéreas is now using de Havilland *Herons* (standard version with 14 seats) on its network. The company has ordered eight *Herons*.

A U.S. Army H-34 helicopter (left) has been making tests at Schleissheim Army Airfield Base, near Munich, with the Decca Navigator Mark 8 and Flight Log (right).

● The turboprop executive aircraft under development at *Beech Aircraft* bears the type designation *Model 112* and is to have two Lycoming T.53 turbines.

● The *SIAI-Marchetti SM.122 O.T.* is a projected all-weather communications aircraft for medium stages, designed to take two propeller turbines. Crew of two plus six passengers; normal gross weight approx. 22,050 to 23,140 lbs. (10,000 to 10,500 kg); range 1,080 to 1,350 nautical miles. Negotiations are in progress regarding the construction of a prototype; meanwhile a mockup is being built.

● *Hispano Aviacion* is working on a high speed communications aircraft, derived from the HA.200-R1 *Saeta* trainer, and with the designation *HA.231-R1*. The main task of the HA.231-R1, which will be a six-seater, will be fast communications services at relatively high altitudes, and observation, photography and training (in the latter case instructor and student sit side by side). Like the *Saeta*, the HA.231-R1 will have two Turboméca *Marboré* jets initially, though Hispano Aviación is considering the use of more powerful *Gabizos* at a later date. Max. gross weight 7,165 lbs; mean cruising speed 275 knots at 24,600 ft; max. range 410 nautical miles at 29,530 ft in still air and with 30 minutes flying reserve.

● The *Lockheed C-130B*, a more powerful version of the C-130 hercules military transport, is now in production at Lockheed's Georgia plant. The C-130B reportedly has Allison T56-A-7 turboprop engines with Aeroproducts 606 four-bladed propellers. The modifications bring the maximum take-off weight of the C-130B up to 135,000 lbs. as against 124,200 lbs. for the C-130A.

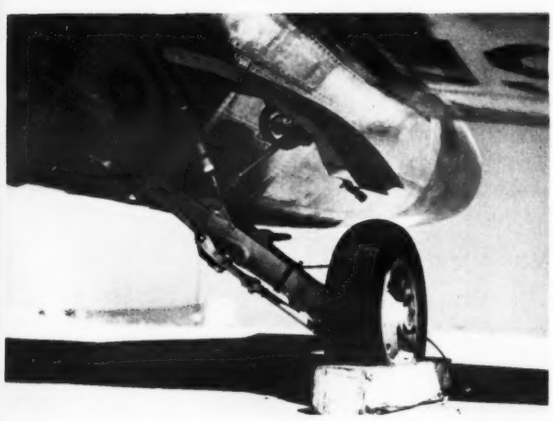
● The Bristol *Orpheus BOr.4* turbojet engine has been specified for the *Fiat G.91T* trainer; the G.91 single-seat fighter is powered by an *Orpheus BOr.3*.

● A new *communications aircraft prototype I.A.45* is nearing completion at the *Fabrica Militar de Aviones*, Cordoba, Argentina. Intended for communications and executive service, the I.A.45 is a five-seat twin-engine high-wing design with tricycle undercarriage; two 150 h.p. Lycoming engines with variable pitch propellers provide a cruising speed of 140 knots; landing speed with flaps down 50 knots; range approximately 590 nautical miles.
Parallel to this project is the *I.A.35* twin-engine multi-purpose aircraft now in production up to a planned total of 100; some 20 of these aircraft will be completed by the end of 1957.
It will be remembered that in addition the Fabrica Militar de Aviones (under the control of the Direccion de Institutos Nacionales de Fabricaciones e Investigaciones Aeronauticas, DINFIA) also builds under licence the Beech *Mentor* two-seat trainer and the Morane-Saulnier MS.760 *Paris* twin-jet communications aircraft.

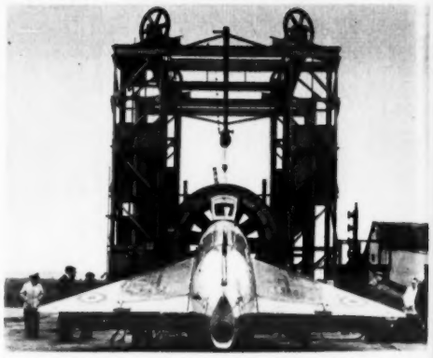
● The first flight date for the *Grumman 159* has been set at May 1st, 1958, by the company. Grumman expects that C.A.A. certification for the new aircraft will be awarded within 7 to 11 months after the first flight.

● The following data have been revealed for the *Orenda Iroquois* twin-compressor jet engine with reheat: dry thrust 20,000+ lbs., length 22 ft. The engine is be installed in the production models of the Avro *Arrow 2* supersonic fighter; the prototype of this aircraft, which is to begin flight testing in the autumn of 1957, has a Pratt & Whitney J75.

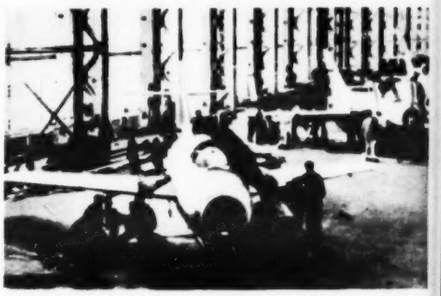
● Générale Aéronautique Marcel Dassault have announced that a project has been prepared for launching the *Dassault Mirage III* single-seat delta-wing fighter from a take-off ramp similar to that used by the American *Matador* missile, in order to increase the aircraft's value as a ground support vehicle. Take-off will be made with the aid of two JATO rockets developing a thrust of 13 tons for 10½ seconds and giving the aircraft an acceleration of 4G.



Lockheed F-104A *Starfighter* under the magnifying glass. Top to bottom: all-moving tailplane and afterburner; jet pipe of the General Electric J 79 jet; the wing has a thickness/chord ratio of 3.4 %; note the leading edge flap which extends over the whole span, and the landing flap; left undercarriage unit (hydraulic retraction mechanism).

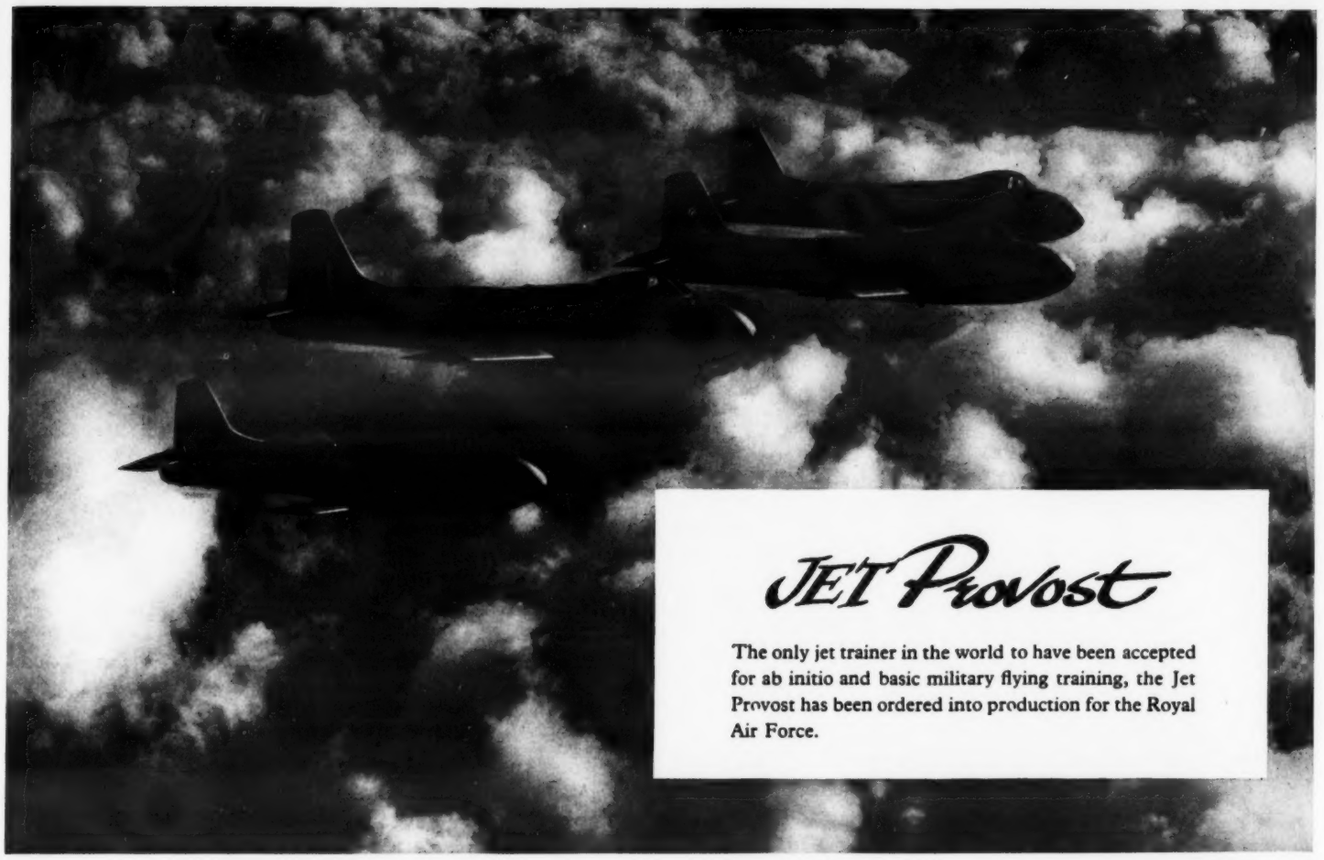


Short SC.1 experimental VTOL aircraft in front of a wind tunnel at Boscombe Down. Here, for example, the behaviour of the cockpit canopy on jettisoning was investigated.



The MiG-17 is being built under licence in China. The assembly shop at the Government Factory; above, the first finished MiG-17s.

The Lockheed *JetStar* nearing completion: ten-seat multi-purpose transport/trainer; two Bristol *Orpheus* jets (mounted in the rear as in the *Caravelle*); speed around 430 knots.



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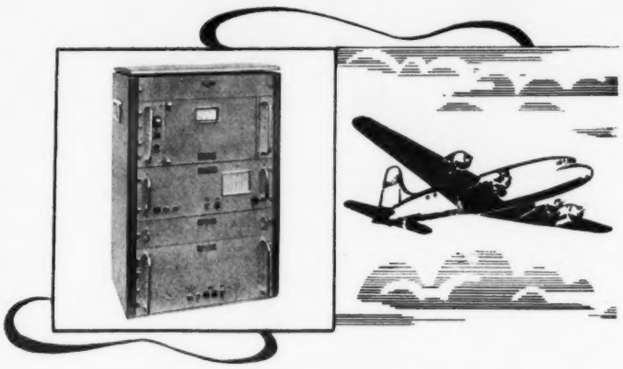

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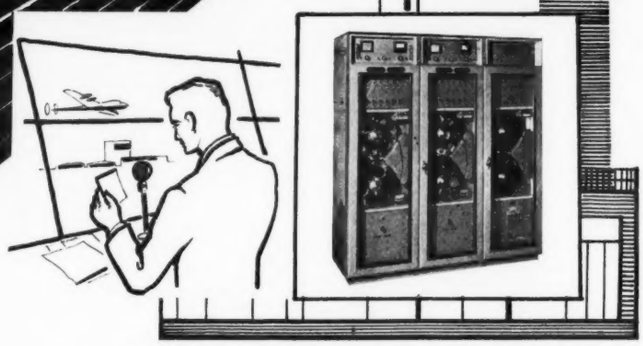

Air Traffic Control. — Multichannel Automatic Recording System. A range of recording installations for air traffic control, to be supplied to the Royal Air Force and Ministry of Transport and Civil Aviation.

Ground Movements Control. — 5 watt and 15 watt mobile transmitter/receiver for all airfield surface vehicles. Illustrated is the new 5 watt transmitter/receiver, type 69.

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The wheels seem amazingly small, compared to the weight and speed of the aircraft.

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Now it pulls to a halt. The whirring blades stop turning.

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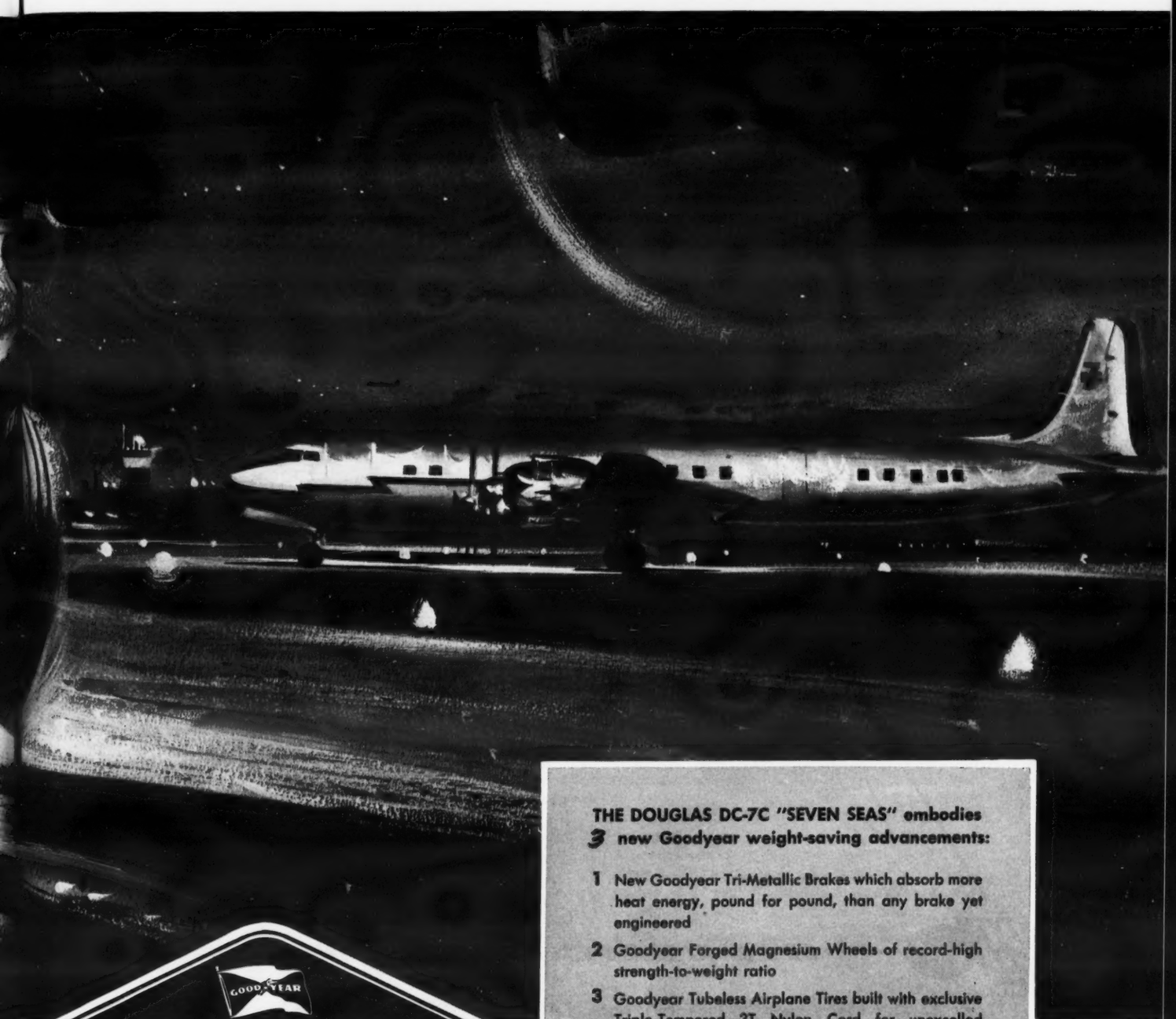
For information on these famed products, write: Goodyear International Corporation, Aviation Products Dept., Akron 16, Ohio, U.S.A., or The Goodyear Tyre & Rubber Company (Great Britain) Ltd., Wolverhampton, England.



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It is a two-unit medium power transmitter with the r.f. and modulator sections assembled in self-contained cubicles combined to form a composite equipment for R/T service. It may be remotely controlled and is fully protected against damage due to overloads or maladjustment. All valves are accessible from the front of the unit and doors at the rear provide easy inspection and maintenance.

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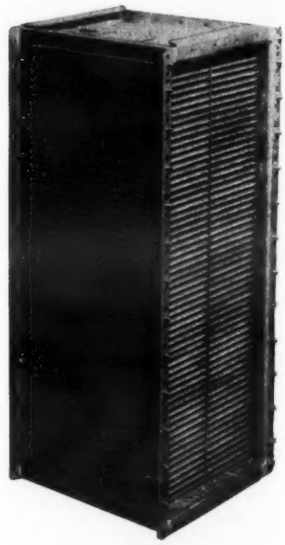


Heat exchangers for many purposes in stainless steel or aluminium alloy. This example specified for the Vickers Viscount anti-icing system.

The I.A.T.A. 13th Annual General Meeting in Madrid

September 9th to 13th, 1957

Opening session, Executive Committee.

Almost every year the impression is that of a " world première ". What other international organization can boast of so efficient a Public Relations Service ? I.A.T.A.'s Public Relations man has erected a throne from which his boss, Sir William P. Hildred, directs his shafts—often shafts of wit. The location may change, but the presentation becomes ever more brilliant and the pomp and circumstance greater; the propaganda machine works well.

This year the Spanish capital had been chosen as meeting-place. Madrid's broad avenues, its art treasures, the dignity of its buildings and of the Spanish hosts recalled the greatness of the Hispanidad which at one time ruled the world. What is more, there is scarcely a major city anywhere else in the world with so many good hotels or such impressive gardens to offer for social events.

During the past two years it has become a custom for the world's aircraft suppliers to join the official hosts of the I.A.T.A. Annual General Meetings in entertaining the representatives of an industry which since 1945 has become a major factor in economy and transport, will soon be transporting a hundred million passengers and hundreds of thousands of tons of cargo a year and can award billion-dollar contracts. Each tried to outdo the others: it began at the Spanish Air Ministry and continued at the Lord Mayor of Madrid's party in the Buen Retiro park; then British, American, French and even Dutch manufacturers vied with one another in hospitality, and the two host airlines—Iberia and Aviaco—provided the finishing touch with their farewell dinner.

Somewhere in the background, there was even some work done. Sir William's organization was as efficient as ever. After welcoming speeches by the Spanish Air Minister and the Lord Mayor of Madrid, retiring President Lord Douglas, of B.E.A., reminded delegates of the problems and anxieties that the jet age, " now a year nearer ", must bring with it. Don Tomás Delgado, of Iberia, I.A.T.A. President for 1957-58, revealed diplomatic gifts, speaking briefly and to the point, and expressing confidence in the abilities of his colleagues. Outwardly, everything went off in perfect harmony.

*

To put a blunt question, what else happened?

Some 250 airline executives, with their retinues and families, some 30 observers from various international organizations, getting on for 100 company presidents and big guns from the aircraft industry's engineering and sales staffs had assembled in Madrid. The mornings were given over to committee meetings behind closed doors, and over luncheon and dinner the talk was often " business ", at any rate indirectly.

The practical results can be summarized in two published decisions. Other matters needing discussion will be thrashed out by the sub-committees during the coming weeks, some of whose sessions may be expected to be stormy.

But let us first discuss the two decisions.

The new President, Don Tomás Delgado (Iberia), takes office; on his left, the Spanish Air Minister.

The Spanish hosts (left to right): Colonel José Pazo (Aviaco), Don Cesar Gomez Lucia (General Manager, Iberia), the Lord Mayor of Madrid and Don Tomás Delgado (President of Iberia and new I.A.T.A. President).

Right to left: René Briend (Air France), Madame Gilbert Périer, Madame René Briend.

The hosts at the farewell American cocktail party (left to right): Mr. and Mrs. Cyrus R. Osborn (Allison), Mr. and Mrs. Robert E. Gross (Lockheed), Mr. and Mrs. Harold A. Dice; Mr. D. Gerdan (Allison).

View of the American aircraft industry's banquet in Buen Retiro Park.

Lord Douglas, B.E.A., with Lady Douglas.

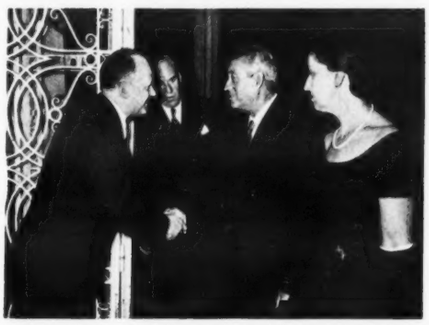
British and American " brothers-in-arms " (left to right): Mr. R. V. Longinotto (Rolls-Royce), Mr. and Mrs. James S. Lee (United Aircraft); Mr. Pearson (Rolls-Royce).

Guests from Southeast Asia (right): Dr. M. Sutoto (Garuda) and Mrs. Sutoto; left, Mr. Nguyen Tan Trung (Air-Vietnam).

A connecting link between all continents (third from right): J. R. D. Tata, President of Air India International and next I.A.T.A. President.

The Allison reception: left, Cyrus R. Osborn (Allison); right, Henry H. Correa (Bendix).

The Sud-Aviation reception: left, M. and Mme. Jakimiuk (Sales Manager); right, partly concealed, Mme and M. Georges Héreil, President of Sud-Aviation, welcome Mr. and Mrs. H. P. Jolly (United Aircraft).



Sud-Aviation President Héreil receiving his guests: right, Mme. and M. José Pazo (Aviaco); in the rear, Capt. K. J. G. Bartlett (Bristol and F.A.I.).

The Sud-Aviation reception: M. and Mme Héreil greeting Mme and M. Gilbert Périer (Sabena).

Centre, Raymond Dupré (Deputy Director General, Engineering, Air France) with General Teyssier (Sud-Aviation).

Air France, Air India International, B.E.A. and B.O.A.C., K.L.M. and South African Airways, Belgium's Sabena and the Scandinavian Airlines System brought in a *proposal that the I.A.T.A. head office should be moved from Montreal to Geneva.* Their main argument was economy; savings in administrative costs, in travel time and expenses for member companies. Geneva, a crossroads of the world's air traffic, was geographically more favourably situated than Montreal, they submitted. Switzerland, with its tradition as a tourist country, offered economic and language advantages. Geneva's international reputation as the headquarters of numerous world organizations would encourage additional airlines to join I.A.T.A. and thus enhance its importance. The Geneva authorities had promised every possible facility. A branch or liaison office could be maintained in Montreal to keep in touch with I.C.A.O., but most of the other offices could be concentrated in Geneva. The move should be carried out not later than December 31st, 1959, provided a sufficient majority approved the proposal.

This was where the difficulty arose. At the instigation of an undisclosed member, it had been agreed that a majority of at least five votes should be required to carry the proposal. In the secret ballot, 30 companies voted for and 29 against Geneva, while 6 abstained. Needless to say, the U.S. airlines were in favour of Montreal, the Europeans, Asians and Africans of Geneva, while the abstainers probably included certain Central American countries, who thus contributed their share to obtaining so clear-cut a result: *I.A.T.A. remains in Montreal.*

The question arises of whether the only reasons for the suggested move were economic ones, or whether there were other motives. Every airfaring country has its own air transport authority to reckon with. America's Civil Aeronautics Board appears to be particularly influential. In view of America's worldwide transport interests, it can intervene indirectly in the air transport policies of almost all other countries and airlines. A move from Montreal to Geneva might perhaps have eased the C.A.B. " yoke " for many companies.

The second decision was for a *reorganization of the Executive Committee*, which has begun to reveal a tendency towards superannuation. During recent years a certain number of airlines have hit upon the, to them, practical solution of delegating to the Committee senior executives nearing retiring age, a procedure that is humanly understandable. In future, however, this vital group is to consist of men who occupy active leading positions in the airlines and actually direct air transport affairs. The first step towards this goal was taken this year. General I. A. Aler, President of K.L.M., replaces his Executive Vice-President F. von Balluseck, who has just retired from active participation in the company; Seijiro Yanagita, President of Japan Air Lines, takes over the seat of Sir Leonard Isitt, of Tasman Empire Airways; Naguib Alamuddin, President of Middle East Airlines, succeeds Prince Pacelli, ex-President of Italy's L.A.I., and Rubem M. Berta, of Brazil's Varig, replaces President Calderón, of Línea Aeropostal Venezolana.

One I.A.T.A. member, who has the occasional habit of speaking his mind, remarked that this is only a

At the reception given by General Dias de Lecea, Spanish Air Minister (pictures left to right): an old comrade-in-arms, General Aldo Urbani, former Chief of Staff of the Italian Air Force, today Vice-President of the new unified Italian airline. — Dr. W. Berchtold, President of Swissair and Mrs. Berchtold. — Mr. W. H. Wicherlink and H. A. Somberg, of Fokker. — J. W. S. Brancker, I.A.T.A. Traffic Director.

beginning; the whole of I.A.T.A. must be "rejuvenated". Even the move to Geneva would not have solved all problems.

To continue on the subject of appointments, mention can be made of the decisions regarding the nomination of next year's President and the location for the next I.A.T.A. Annual General Meeting. The 14th Annual General Meeting will be held in New Delhi on October 27th, 1958, and J. R. D. Tata, President of Air India International, will relieve Don Tomás Delgado as I.A.T.A. President. The 1959 Meeting will be held in Tokyo, where Seijiro Yanagita, President of Japan Air Lines, will take over the office from J. R. D. Tata.

*

All that remains here is to touch on a few points which—important as they may be—are basically routine work.

Today, now that Aeronaves de Mexico and Flying Tiger Line, of Burbank, California, have joined their ranks, I.A.T.A. member airlines number 81; of these, 73 are full members, and 8 are Associate members (without vote).

The 1957-58 I.A.T.A. administration budget estimates receipts of $1,073,500 and expenditures of $1,290,000, the balance of $216,500 being taken from the reserve fund.

Membership fees remain basically unchanged, and vary according to the number of revenue tonne-kilometres flown during the calendar year, on a descending scale. The maximum annual dues for any one company are $101,400.

Since a jet airliner represents an investment of several million dollars, there is much talk of aircraft charter between the various airlines. Not every company can fully utilize a jet fleet at all times, and many would welcome an opportunity of chartering aircraft for short periods.

The main battle within I.A.T.A., however, will probably have been joined during the traffic conference in Miami Beach, due to open on September 24th, 1957. Here some of the larger U.S. airlines are expected to propose rate reductions, for example through the introduction of overseas third-class services, while other companies will wish to retain present rates or even in some cases raise them. The importance of this question is obvious, not only for the operators and the travelling public, but also as regards the recurrent complaint that I.A.T.A. is nothing more than a strictly organized cartel for the maintenance of high fares. This time Sir William Hildred may have some trouble in refuting the charge, but will doubtless succeed as usual.

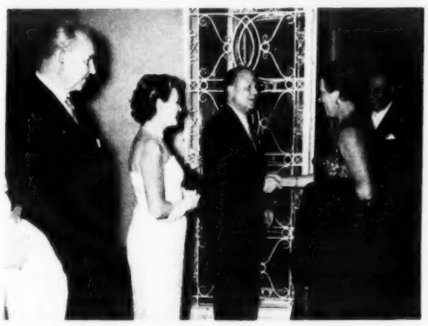
*

For the benefit of readers—and they will be the majority—who did not attend the Madrid meeting, the pictures on these pages will give some idea of the festivities. With more than 600 persons present, the Editors will be forgiven if they have inadvertently overlooked one or another airline or industry representative.

EEH

Second from right: Dr. Igor Sikorsky with friends.

Vickers and Rolls-Royce reception: right, Dr. and Mrs. Haas (Swissair).



M. and Mme Héreil welcoming General and Mme Urbani.

General Fayet (Director General, T.A.I.) and Mrs. Fayet; centre, a friend from Viet-Nam.

General R. W. Douglass (United Aircraft).

Vickers and Rolls-Royce reception: left to right, Don Juan Viniegra (Iberia), Mr. Robert Handasyde (Vickers), Mr. and Mrs. Pearson (Rolls-Royce).

Guests of the Americans: right to left, Lady Hildred, Sir William P. Hildred, M. W. Deswarte (Sabena).

Aircraft and engine manufacturers shake hands: centre, Leonard K. Schwartz (Lockheed), on his left, Cyrus R. Osborn (Allison).

Canadian guests: right, J. G. Notman (President of Canadair), far left, Mrs. Notman; centre, G. W. G. McConachie (Canadian Pacific Airlines) and wife.

Gipsy dances at the Sud-Aviation reception.

Don Cesar Gomez Lucia (Iberia) greets the author.

A Fokker table: centre, J. Gerritsen; right, H. A. Somberg.

Centre, John C. Leslie (P.A.A.).

Right, K. J. Luplow and wife (Boeing); second from left, Armin Baltensweiler (Director of Planning, Swissair).

Left, J. R. Patterson (United Aircraft) with friend.

A German table: centre, Hans M. Bongers (member of the Deutsche Lufthansa management); left, Herbert Gloss, his Spanish representative.

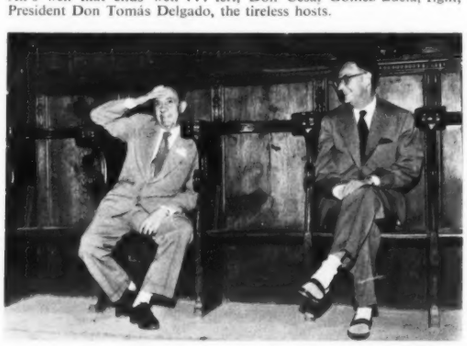
A British table: Napier's always active representatives.

Japan Air Lines executives . . . rear, a Spanish grandee.

Left, President Héreil (Sud-Aviation); centre, Colonel L. Serrano de Pablo (Secretary General of the Spanish Aero Club), who lent his premises for the Sud-Aviation reception.

Left, Mr. R. J. Pfeiffer(Fairchild) and Mrs. Pfeiffer.

All's well that ends well . . . left, Don Cesar Gomez Lucia, right, President Don Tomás Delgado, the tireless hosts.



A DECADE OF THE I.A.T.A. CLEARING HOUSE

One bright spot in every report submitted by the I.A.T.A. Financial Committee to the Annual General Meeting is the chapter headed " Clearing House ". This is not surprising : a total staff of only eight, headed by A. J. Quin-Harkin, with offices at 30 Curzon Street, London, handles the entire clearing business between 60 I.A.T.A. member airlines from 48 countries and—in collaboration with the Air Transport Association of America's clearing house—18 North American domestic airlines. Monthly sums handled in 1956 varied between $30,000,000 and $48,000,000, with an average of 88 % of all claims being offset without transfer of cash. During the ten years of its activity to date (January 1947 to January 1957), the Clearing House has handled business totalling $2,235,000,000. The following table reveals the constant increase in sums handled each year and the reduction in the charges levied against the member airlines (per $1,000 handled).

Year	Two-way turnover	Offset	Cost
1947	$ 52 000 000	64 %	$1.30
1948	124 000 000	78	0.98
1949	135 000 000	84	0.75
1950	148 000 000	84	0.66
1951	170 000 000	86	0.51
1952	218 000 000	88	0.40
1953	242 000 000	88	0.37
1954	287 000 000	89	0.29
1955	366 000 000	88	0.25
1956	493 000 000	88	0.19

Operating Results of I.A.T.A. Members
(scheduled services)

	1950	1953	1956
Membership	62	70	76
Revenue km. flown (millions)	1 062	1 478	1 974
Revenue passengers carried (thousands)	23 300	39 373	58 554
Revenue passenger km. flown (millions)	22 800	40 350	62 476
Available seat-km (millions)	36 800	63 137	97 807
Revenue passenger load factor	62.0 %	63.9 %	63.9 %
Revenue Tonne-km. Performed (millions)			
Passengers (including free baggage)	2 046	3 609	5 553
Excess baggage	30	57	85
Freight	515	685	993
Mail	176	252	371
Total	2 757	4 603	7 002
Average passengers per aircraft	21.5	27.3	31.6
Number of employees (thousands)	181	242	304
Operating fleet		2 500	2 790

North Atlantic Traffic of the I.A.T.A. Members
(scheduled services *)

	1950	1953	1956
Total flights	10 942	14 669	22 852
Seating capacity	495 561	781 737	1 226 861
Passengers	311 545	506 601	785 259
Load factor	62.9 %	64.8 %	64.0 %
Cargo (in tonnes)	6 235	8 877	18 504
Mail (in tonnes)	3 481	4 957	8 458

* both ways

I.C.A.O. and the Jet Age

by Léon Boussard,
Chief, Public Information, I.C.A.O., Montreal

For some time past I.C.A.O.'s Air Navigation Bureau and Air Navigation Commission have been studying and cataloguing technical data on the development of jet aviation and its potentialities in the near and distant future.

When the Assembly met at Caracas in June-July 1956, the Member States of the Organization had already received from I.C.A.O. a working paper which set out the essential facts and forecasts and explained to governments the vast range of the problem, the need for immediate measures, the vital importance of an intensive effort for the implementation of regional plans, for the introduction of large commercial turbojet and turboprop transport aircraft.

It is plain from this document that there is no time to lose. The approaching operation of long distance, high-speed aircraft, with cruising speeds of some 500 knots, operating altitudes of 39,000 ft., total take-off weights approaching 300,000 lb. for the longest stages, and requiring runway lengths of 10,000 ft. and a world network of upper air meteorological observations up to a minimum of 50,000 ft., imposes certain conditions regarding airports, air traffic control zones, landing areas, telecommunications, navigation aids, and the mechanization of control operations. This applies also to the air terminals, which must provide for the rapid handling of 150 or 175 passengers for each flight, since the operation of these aircraft will have become routine by 1960, and will probably continue for another fifteen or twenty years.

With the introduction of new aircraft, I.C.A.O. also foresees a great increase in air traffic as a whole, with the figure for passenger-miles transported by the scheduled airlines of the world rising, by 1980, to thirteen times the 1955 figure, or 500,000,000,000. The total number of miles flown would increase only fourfold, since the number of passenger-miles would rise more quickly owing to the greater passenger capacity of the commercial transport aircraft of the future.

To ensure that the necessary studies and initial steps should be made known without delay, the Assembly at Caracas decided that a panel of experts be established to assist the Air Navigation Commission and the I.C.A.O. Council in their work. These experts were to have a thorough understanding of the problems of international civil aviation, and their task would be to study the introduction throughout the world of special facilities and air navigation services to cater for the jet era. The members of the group, which soon became known as the I.C.A.O. *Jet Age Task Force*, were chosen by the former President of the Council, Dr. Edward Warner, who retired in April 1957; they started work immediately. Meetings were held in Montreal, Paris, Lima and Mexico (and a further one scheduled for the end of September 1957 in Paris). At these meetings, the members of the group embarked on a detailed study of I.C.A.O.'s regional plans and the extent to which they had been implemented, thus acquiring a better understanding of the particular problems and deficiencies in I.C.A.O.'s eight air navigation regions: North Atlantic, Caribbean, South America, European-Mediterranean, Middle East, Africa-Indian Ocean, Pacific, South-East Asia and South-West Pacific.

To facilitate the work of the Jet Age Task Force, Walter Binaghi, President of the I.C.A.O. Council, recently visited thirteen Latin American countries. Here he is landing in Lima, Peru, with C. J. Tippett, I.C.A.O. Representative of the South American Office.

Apart from meetings of the group there have been journeys and missions for on-the-spot discussions with representatives of governments and aeronautical administrations.

In its work and proposals submitted for discussion by the Council, this group will bear in mind not only the difficulties of each particular region and government, the plans already drawn up at regional air navigation meetings, the latest information supplied by jet aircraft manufacturers, airlines and their pilots, but also the statements and suggestions of the *Jet Operations Requirements Panel.*

It was also at Caracas that the Council decided to appoint this latter group of experts, comprising representatives from administrations, manufacturers, airlines, pilots and even the military services. Their task was first to define as clearly as possible the requirements of tomorrow's air transport, and then to make proposals on how they might be met. Extensive unofficial discussions have taken place outside the official work of this group. Three reports have been prepared for the Air Navigation Commission, setting out the latest and most precise information concerning the operation and the basic needs of these new types of aircraft. The essential task of this group was thus to try and sort out the mass of information which had hitherto been presented in a rather haphazard and chaotic fashion, and to draw up a detailed inventory of the requirements of the jet age.

As predicted, it has been clearly shown that the difficulties of transition to the jet era are not only technical but economic.

*

It can honestly be said that all the governments have been most anxious to improve air navigation services, installations and facilities in their

I.C.A.O.'s Jet Age Task Force arriving by piston-engine aircraft. Right to left : René Lemaire (France), Walter Binaghi (President of the I.C.A.O. Council), A.P. Dekker (Netherlands), Dr. Edward Warner (former President of the I.C.A.O. Council), Brigadier General Helio Costa (Brazil), Dr. Roberto L. C. Pimentel (Brazilian Air Ministry), Air Vice Marshal Sir Victor Tait (United Kingdom), L. C. Boussard (Chief, Public Information, I.C.A.O.), Colonel Luiz Azcárraga (Spain).

regions, not only to meet the existing needs of international aviation but also in anticipation of the introduction of jet aircraft. However, despite I.C.A.O.'s endeavours to bring some uniformity to this forever shrinking world, there will always be differences and variations, even within the vast, and sometimes overlapping, air navigation regions themselves—differences due to climate, meteorology and the very nature of the soil. For the earth, even in the age of aviation, still belongs to man.

In certain areas with a high density of air traffic, and characterized by a mosaic of nations, strange mixtures of traditions and customs, immense and numerous urban centres, agreements must be reached in order to ensure that the high-speed services of these new aircraft shall not be hampered. In other regions there are steaming jungles, barren deserts, bare and jagged mountain ranges and other natural obstacles which have made surface travel impossible and where the aircraft is the only key to the problems of transport. It is in just these areas where fundamental changes must be made and practical measures taken. There are countries whose entire economy would collapse without air services. In other countries economic resources are insufficient to allow their governments to complete work which they have embarked on with enthusiasm, and which should benefit the entire international community. These problems, too, must be solved, along with the technical ones.

Various economic solutions are possible. Financing might be provided, for example, by the interested States jointly, by the users, or by a technical assistance scheme. The most difficult problem world be the training of the ground personnel, in particular control and supervisory personnel, responsible for the proper working and upkeep of communications, meteorological air traffic control and all other ground facilities.

Orders already placed by the major airlines (about 340 jets), indicate:

— that the capacity of international civil aviation will be doubled;
— that the speed of air transport will increase by 40 per cent;
— that there will be a substantial rise in operating costs, offset, however, by the increased traffic potentials for all categories of transport.

The conquest of space is only beginning. In spite of the progress made and the journeys into the lower layers of space during the past fifty years, we probably know less about air navigation than the Phoenicians knew about maritime navigation. For, after all, we are still in the age of air cabotage, merely touching the fringe of space.

Thus it can be seen how vital and how useful have been the joint efforts of Member States and all the I.C.A.O. services in this field of activity. For without the pooling of knowledge and ideas, it would be impossible to use to the full the astounding discoveries made through the ingenuity and industry of man.

European Common Market and Air Transport

by Maurice Lemoine, Vice-President, Société Française de Droit Aérien

The European Common Market agreement does not cover air transport, despite the fact that this branch of commercial activity presents a number of problems in Europe. For several years politicians, government officials and airline executives have been discussing these problems and, with varying degrees of urgency, seeking solutions to them. On the inter-government level the question was last studied at the Madrid meeting of the European Civil Aviation Conference in April and May this year.

The object of the present article is to outline the work already undertaken, assess briefly the results achieved and attempt an analysis of the reasons for the setbacks experienced and the directions in which fruitful efforts can still be made.

Main features of European air transport

One of the fundamental factors affecting air transport in Europe is undeniably the political division of the continent into comparatively small national areas. In very many cases territories are too small to support any extensive network of domestic air services, and in Europe as a whole air transport is always mainly, and sometimes solely, an export industry.

The short distances between most of the big population and economic centres greatly reduces the attraction of air services. Such short stage lengths also affect costs, since they make it impossible to use equipment economically or spread the take-off, landing and other airport charges over a sufficient number of aircraft miles.[1]

These difficulties are supplemented by other problems arising from national legislations and the policies followed by the various countries.

Any airline wishing to operate scheduled services (or, in practice, engage in non-scheduled operations) must first obtain authorization from the governments concerned. Individual authorizations, negotiated under bilateral agreements, may contain widely varying clauses. Another difficulty is that, with the exception of the Scandinavian countries, each European State insists on having its own national airline and seeing its flag aircraft operating on the international routes.

The result of these two latter factors is that air services inside Europe are operated in a labyrinth of disparate authorizations which are incompatible with any coherent overall system. In negotiating air transport agreements, each country is naturally concerned not so much with European air transport as a whole as with its own airlines. Since all are intent on securing the best possible position for themselves, the transport capacity offered on some routes is too high and on others too low, timetables are drawn up so that rival services depart at roughly the same times and, in general, personnel and equipment are employed uneconomically.

Such is, in broad outline, the situation as seen by the advocates of the European concept in air transport. Their object is to decide what changes it is desirable and possible to make.

The search for a European air transport policy

In the immediate post-war period intra-European transport was considered as a part of general international civil aviation and was not treated as a separate subject of discussion until 1950. By 1951 three different projects had been prepared for its future : the Sforza project presented to the Council of Ministers on behalf of the Special Transport Commission, and the Bonnefous and van de Kieft projects presented to the Council of Europe on behalf of the Economic Affairs Commission. The preparation of three different plans reveals the interest shown in the question.

Each of the projects was restricted to general principles, without regard to the problems of applying them in practice.

The Italian project advocated, in essentials, the creation of an airspace common to all the European countries and the introduction of freedom of traffic within this airspace, under the control of a common authority.

The central proposal in the Bonnefous project was for the creation of a transport authority to be responsible for preparing and putting into effect, in collaboration with the countries concerned, an improved organization for European transport. As regards air transport, it was proposed that an international company or consortium should be founded to distribute routes and services among the airlines in such a way as to intensify air traffic, cut costs and reduce fares.

Finally, the van de Kieft project recommended that the airlines combine to form a single European organization, in the form of a charter company or consortium, to be responsible for air services between the organization's member countries.

Nothing came of these projects, perhaps because when they were put forward they were in advance of general thinking. Aware of this fact and realizing the differences between the various proposals, the Council of Ministers decided on March 19th, 1953, to turn the study of the problem over to a conference, which was held in Strasbourg from April 20th to May 8th, 1954, under the title " Conference on the Coordination of European Air Transport ".

European Civil Aviation Conference

The 1954 Conference decided to set up a permanent European Civil Aviation Conference to follow up the question of air transport in Europe. The Conference met for the first time in Strasbourg in November 1955 and the second time in Madrid on April 24th, 1957.

The E.C.A.C. began by repeating on the European level certain attempts which had been made without success by the International Civil Aviation Organization on the world level. More precisely, it tried to draft, and to persuade governments to accept, an operating system for scheduled international services to be applicable inside Europe in the place of the Chicago

[1] B.E.A. has calculated, for example, that total seat-mile costs for the *Viscount 701* are 2.26 pence for a stage length of 1,000 miles, but rise to 4.75 pence for a stage length of 200 miles.

The Jet Operations Requirements Panel Report

The following are the principal recommendations made by I.C.A.O.'s Jet Operations Requirements Panel in its report published on September 5th, 1957.

Airports

The noise caused by turbine-engine aircraft should be reduced to the maximum possible extent and should be consistent with that presently accepted on or in the vicinity of the airport.

As fuel consumption during taxiing is high, taxiways should be laid out to make taxiing time as short as possible, and to allow for turns at speeds between 30 and 45 knots.

Increased speeds for landing highlight the need for improvements in visual aids both on the approach and on the runway. There is also a necessity for some means to assist the pilot to determine whether his take-off is developing safely : runway distance markers and devices in the aircraft to measure acceleration may meet this requirement.

Traffic Control and Navigation

In those portions of the airspace where jet operations are carried out, there must be positive air traffic control at all times, regardless of weather conditions. This also requires integration with military traffic, a problem which will now extend from the lower altitudes to the higher levels of the airspace.

Because of fuel penalties, no jet aircraft should encounter delay between the time it starts its engines and the time it climbs onto its course. This involves procedures designed to facilitate uninterrupted taxiing, take-off and departure clearances, and requires the airport to have facilities allowing jets to bypass piston-engine aircraft which are running up their engines at the beginning of the runway. The turbine-engine aircraft should be permitted to make an uninterrupted climb to initial cruising altitude. Because of high altitude and speed, jet aircraft will have to begin their descent at considerable distances from the terminal airport. The pilot must be notified of any potential landing delay to enable him to absorb the delay before he commences his descent.

Increasing traffic densities and the special requirements for optimum operation of jet aircraft require the adoption of a medium-and short-range navigation aid, based on the area coverage system and providing pictorial presentation to the pilot in the cockpit.

So that holding patterns can be accurately defined and maintained, there will be a need for special radio navigation aids, since those provided for conventional aircraft may be unsatisfactory. Unrestricted climb to cruising altitude and precision in descent from cruising altitude are important requirements in the operation of jet aircraft. In each case there is need for an aid which will enable the jet aircraft to maintain a prescribed track with adequate precision and to have an accurate knowledge of its distance along the track.

Depending on local conditions, an aid may be required at large aerodromes to expedite aerodrome traffic and in particular to enable turbine-engine aircraft to proceed on the ground to take-off position rapidly (aerodrome surface surveillance radar might solve this problem). Surveillance radar will be required as an aid to air traffic control at most aerodromes handling jet traffic and in some areas for control of en-routre traffic.

New communications techniques to meet the jet requirements for air traffic and meteorological services will be necessary : these techniques would include radioteletype broadcasts of weather information for receipt on board the aircraft in printed form, radio facsimile broadcasts, continuous weather broadcasts, extension of direct-voice communications between controllers and pilots, improved systems of high-frequency radiotelephony such as the compatible single sideband system, automatic calling devices, and automatic signalling and data transfer systems for air traffic control purposes.

Meteorology

Meteorological services must be provided to serve operations up to a pressure altitude of at least 14,000 metres or 45,000 feet.

For pre-flight planning, forecasts are necessary as follows ; with an accuracy of $\pm 1°$ C, a forecast of air temperature along the runway to be used, at the average height of turbine-engine intakes, to be ready two hours before take-off : a forecast of the wind velocity during climb to initial cruising altitude ; forecasts of the air temperature at selected pressure levels with an accuracy of $\pm 3°$ C. At least when instrument meteorological conditions are expected, the pilot should have a landing forecast for his terminal airport and for his first alternate before he arrives at the point where he must make his decision to descend or to divert his flight. Landing forecasts should be kept under continuous review and amended as necessary.

system. This would have put an end to the present system of bilateral agreements with their discriminatory clauses and varying conditions, and above all would have introduced uniform standards for operators' rights and duties in relation to governments. But E.C.A.C.'s efforts were no more successful than I.C.A.O.'s.

The Conference then turned to a search for multilateral agreements of very much narrower scope, so to speak lowering their sights to targets more likely to be attainable. Thus in 1955 it drafted a " Multilateral agreement on commercial rights for non-scheduled traffic in Europe " which was signed by fifteen countries [2], and planned to prepare a multilateral agreement on the transport of cargo.

Can the first of these agreements be described as a success and regarded as an encouragement for E.C.A.C. to persevere in its chosen line of " partial solutions " ? Even assuming that a substantial number of countries ratify the agreement, it is essential to realize how limited is its scope. Based on Article 5 of the Chicago Convention, it provides for the systematic grant of transit and commercial rights for certain categories of non-scheduled traffic operated at low frequencies by aircraft belonging to the signatory countries. These categories are flights made for humanitarian reasons or in cases of urgent necessity ; occasional charter flights by taxi aircraft with not more than six seats ; flights by aircraft chartered in their entirety by one person or one group of persons ; flights limited, for each operator or group of operators, to one per month between two given centres.

A study of these points suggests that the small degree of liberalization introduced will not do anything sensational towards transforming European air transport.

The other transport categories covered, namely pure freight operations and the transport of passengers between regions not at present adequately served by scheduled operators, might be of greater interest. But on these points the agreement is so hedged around with precautions that nothing really valuable can be expected from it. It provides, namely, that any contracting State can demand the suspension of any services under these two categories if it considers them to be prejudicial to the interests of the scheduled services which it operates in the territories affected by the agreement.

[2] Austria, Belgium, Denmark, France, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Spain, Sweden, Switzerland, Turkey and West Germany.

The E.C.A.C. changes direction

The resolutions passed and the working programmes adopted by the E.C.A.C. at its last meeting in Madrid reveal that the Conference has relegated the basic problems to second place and is in future to direct its main efforts to a search for practical measures designed to lighten the burden imposed on European air transport by the time-consuming formalities and the charges of all kinds resulting from the many political frontiers. In this way, E.C.A.C. is extending the efforts of I.C.A.O.'s Facilitations Division and, by reducing its field of activity to the European scale, finds greater prospects of success in some directions than I.C.A.O. has had in attempting to arrive at solutions valid throughout the world.

At the same time, E.C.A.C. is encouraging European airlines to form associations or sign agreements designed to improve operating economics. Typical examples are the work in progress on the standardization of aircraft, and the international recognition of certificates of airworthiness and flying licences.

All these are questions passed to E.C.A.C. by the 1954 Strasbourg Conference, though at that time they were considered as questions of secondary importance. Today they have moved up into first place.

The lessons of experience

A comparison between the efforts undertaken during the past ten years and the results obtained points several lessons.

- E.C.A.C. meets with the same lack of success, and for the same reasons, as I.C.A.O. when it tries to reconcile the diverging interests of countries entrenched behind the doctrine of nationalism.
- It seems clear today that E.C.A.C. cannot by its own efforts change the " rules of the game " or replace the present system of granting commercial rights under bilateral agreements by a uniform and coherent system.
- The stumbling blocks are well known. In the first place, any attempt to deal with intra-European air services as a separate problem overlooks their role in support or extension of intercontinental services.
- However, the major difficulty undoubtedly stems from the difference in the European countries' geographical and economic situations, in the standards of living of their peoples and in their traffic potentials. The position is often further complicated by the disparity between a country's general economic activity and foreign trade on the one hand, and its commercial aviation aims on the other.

It is true that the liberalization of transport may lead to such an expansion in traffic that all will profit eventually. But the E.C.A.C. cannot be expected to attempt the experiment, since economic problems outside its competency are involved.

- Under these conditions, the E.C.A.C. may perhaps accomplish useful work in introducing broader facilitation measures or arriving at mutual assistance accords between airlines. However, when it comes to transforming the widely varying services offered by the different European national airlines into a harmonious, efficient and economic transport system appropriate to Europe's needs, progress will continue to depend primarily on the attitude taken up by governments.

Book Reviews

Mécanique des fluides théorique. — By Maurice Giqueaux, 2nd edition revised and enlarged with the collaboration of Adalbert Oudart. Librairie Polytechnique Ch. Béranger, Paris, 1957 (French, 426 pages, 134 figures, 8,800 French francs).

A basic textbook on the theory of the mechanics of fluids. The first edition, rapidly sold out, has been considerably revised: the chapter on analytical functions has been eliminated, the theory of propeller eddies and interactions has been divided into two separate chapters, and the chapters on boundary layer and compressibility have been substantially modified and enlarged. The reader will find, in particular, articles on the boundary layer with thermal exchanges and on the phenomena which accompany an aircraft's passage through the sound barrier. So.

Illustrierte Technische Wörterbücher, Volume XVII, Aeronautics. — Edited by Alfred Schlomann. — Published by R. Oldenbourg Verlag G.m.b.H., Munich, 1957 (German, English, French, Italian : 755 pages, price DM. 64.—).

An old friend has reappeared—the excellent four-language illustrated aeronautical technical dictionary by Schlomann which was first published in 1932. Many things have changed in aeronautics in the past quarter of a century, and it is therefore surprising that the Publishers did not attempt to bring this dictionary up to date and contented themselves simply with reproducing the book of 1932. Equally surprising is the fact that even in its 1932 version the dictionary is of immense value to the technical translator. Ed.

L'industrie aéronautique. — By Daniel Molho and Raymond Pelladan. — Published in the " Que sais-je? " collection by Presses Universitaires de France, Paris, 1957 (French, 120 pages, price 156 francs).

After briefly outlining the history of the aircraft industry, the authors, both of them members of France's *Institut du Transport Aérien*, discuss the various phases in the production of an aircraft (initial programme, research, stages of production, industrial resources, financial resources, sub-contractors, time required for production, processes and structural materials). Finally, a series of chapters are devoted to each of the world's aircraft industries.

Despite its brevity, this little book describes in remarkably clear and lively manner the past and present activities of the industry's engineers and managements throughout the world. So.

Vision, A Saga of the Sky. — By Harold Mansfield. — Duell, Sloan and Pearce, New York, 1956 (English, 389 pages, $5.00).

This is the 40-year story of the struggles of the American aircraft industry and of the transformation of the aeroplane from a stick-and-wire contraption into today's modern jet fighter, bomber and transport. Although the book describes the trials, tribulations and triumphs of a single company—the author is the Public Relations chief of Boeing Airplane Company—it nevertheless gives a clear idea of what the early pioneers were up against in trying to overcome the complacency of certain defence officials who refused to admit even before World War II that America was lagging behind in air power. It is interesting to note, for instance, that the B-17 *Flying Fortress*, famous for its rôle in the air war in Europe, had to wait five years before the authorities found a " requirement " for it and that its successor, the B-29 *Superfortress*, received no recognition until three years after the first prototype flight. In addition to being an interesting history of a large firm, *Vision* is a warning that it takes continuous, unrelenting effort to stay ahead in our divided world. Ed.

Brassey's Annual, The Armed Forces Year-Book, 1956. Sixty-seventh Edition — Edited by Rear-Admiral H. G. Thursfield. — William Clowes & Sons Ltd., London, and The MacMillan Company, New York (English, about 450 pages).

The latest edition of this classical annual appraisal of the strategic, tactical and administrative problems confronting the armed forces studies, in 29 well-documented chapters, a variety of aspects of the military situation as it presents itself today. American, British, Australian and other experts examine such problems as *Integration of the Services, The Future Structure of the Armed Forces, Sea Power and Russia, Problems of Middle East Strategy, Jet Bomber Flying, Aircraft*

BRITISH GROUND AERADIO AND COMMUNICATIONS EQUIPMENT

Information supplied by International Aeradio Ltd., London

Category	Manufacturer	Type	Power output	Frequency range (Mc/s)	Channels	Type of Transmission
UHF Transmitters	Plessey	T 7355	10 W	225-400	1	RT
	Plessey	T 7096	10 W	225-400	1 (1750)	RT
	Plessey	T 7355/A9365	100 W	225-400	1	RT
	Plessey	T 7096/A7349	100 W	225-400	1 (1750)	RT
UHF Receivers	Plessey	R 7351		225-400	1	RT
	Plessey	R 7109		225-400	1 (1750)	RT
VHF Transmitters	Pye	PTC 3600	1 kW	115-140	1	RT
	Pye	PTC 351	50 W	38-185	1	RT
	Plessey	PT 15A	50 W	100-156	1	RT
	Redifon	G 71	50 W	116-132	1	RT
	Marconi	AD 801	50 W	100-156	1	RT
	Pye	PTC 723/4	15 W	60-185	1	RT
	British Communications Corp.	143	25 W	40-184	1	RT
	Marconi	AD 811	15 W	100-156	1	RT
	Ekco	CE 91	20 W	100-156	1	RT
	British Communications Corp.	301	50 W	30-174	1	RT
	Murphy	TM 371 (MR370)	50 W	100-156	1 (560)	RT
VHF Receivers	Pye	PTC 723/4		30-185	1	RT
	Ekco	CE 6		100-156	1	CW/RT
	GEC	BRT 186		54-186	1	RT
	Marconi	AD 818		100-156	1	RT
	Redifon	R 72		116-132	1	RT
	Eddystone	770 R		19-165	variable	CW/RT
	British Communications Corp.	126		40-184	1	RT
	Plessey	PR 72		100-156	1	RT
	Murphy	RX 372 (MR 370)		100-156	1 (560)	RT
HF Transmitters	Mullard	GFT 560/2	2/3 kW	1.5-30	variable	CW/MCW/RT
	Marconi	HC 200	2,5 kW	2-27.5	variable	CW/MCW/RT
	Redifon	G 67	2,5 kW	2-23	variable	CW/MCW/RT
	Mullard	GFT 560	1 kW	1.5-30	variable	CW/MCW/RT/ SSB
	Redifon	G 143	1 kW	2-26	1 (10)	CW/MCW/RT
	Redifon	G 40A-D	500/750 W	0.137-25	autotune 2 (max.)	CW/MCW/RT
	Marconi	TGS/571	500 W	2.5-20	1 (6)	CW/MCW/RT
	Marconi	HC 100	400 W	1.6-27.5	autotune 4	CW/MCW/RT
	Cossor	T 1509	300 W	1.5-20	1	CW/MCW/RT
	Marconi	TGS 541 B	200 W	1.5-23	1 (6)	CW/MCW/RT
	Redifon	G 77	150 W	1.5-24	autotune 1	CW/RT
	Pye	PTC 931	60 W	1.6-14	1 (4)	CW/MCW/RT
	Redifon	G 61 P	50 W	2.5-10	1 (5)	CW/RT
	Plessey	PT 99	50 W	2-15	1	CW/RT
	Marconi	TGS 501	100 W	1.5-13	1	CW/MCW/RT
HF Receivers (tunable)	Eddystone	840 A		0.480-30.6		CW/MCW/RT
	Eddystone	680 X		0.480-30		CW/MCW/RT
	GEC	BRT 400		0.150-0.385 0.51-30		CW/MCW/RT
	Redifon	R 50 M		0.013-32		CW/MCW/RT
	Airmec	C 864		0.015-0.045 0.100-30		CW/MCW/RT
	Marconi	CR 150/6		2-32		CW/MCW/RT
	Racal	RA 17		2-30		CW/MCW/RT
	Redifon	R 150		0.585-32		CW/MCW/RT
	Redifon	R 145		2-30		CW/MCW/RT
	Redifon	R 146		0.250-24		CW/MCW/RT
	Marconi	NS 702		0.015-28		CW/MCW/RT
HF Receivers (fixed frequencies)	Plessey	PR 51 C		2-30	1	CW/MCW/RT
	Redifon	R 151		2-27.5	1 (6)	CW/MCW/RT/ RTT
	Redifon	R 93		2-20	1	CW/MCW/RT
	Plessey	PR 53 A		2-30	1	CW/RTT
	Marconi	HR 51		3-27.5	1 (3)	CW/MCW/RT
	Marconi	HR 54		2-27.5	1 (5)	CW/MCW/RT
	Plessey	PV 98		2.5-27.5	1 (5)	CW/MCW/RT
	Redifon	R 304		2-10	1 (5)	CW/MCW/RT
HF Transmitters/ Receivers	Marconi	HSR. 11	50 W	2-12	1	CW/RT
	Pye	PTC. 790 D	60 W	1.6-14	1 (4)	CW/MCW/RT
	Redifon	GR. 164	3.5-5 W	2.5-9	1 (3)	CW/RT
	Redifon	GR. 250	25-50 W	2-12.5	1 (5)	CW/MCW/RT
	Redifon	GR. 49	50 W	2-10	1 (5)	CW/RT
	Pye	C. 12	5-7 W	1.6-10	1	CW/RT
	British Communications Corp.	HF. 15 B	1.5 W	2.5-7.5	1 (2)	CW/RT
	Marconi	HP. 21 A	1,5 W	2.5-8.5	1 (2)	CW/RT
	Marconi	HP. 31 A	10 W	2.5-8.5	1	CW/RT
	Mullard	GNE. 510	40 W	1.5-12.5	1 (8)	CW/MCW/RT
	Cossor	104	7 W	2-8	1 (2)	CW/RT

The table does not claim to list all ground radio equipment which can be used for aviation purposes. CW = Continuous Waves; MCW = Modulated Continuous Waves; RT = Radio Telephony; RTT = Radio Teletype; SSB = Single Sideband. In the column showing channels the figures in brackets indicate the number of frequencies to which the equipment can be tuned. For example, 4 (1750) = 4 -channel equipment tunable to 1750 different frequencies.

BRITISH GROUND RADIO AND RADAR AIDS TO NAVIGATION

Information supplied by International Aeradio Ltd., London

Application	System	Manufacturer	Type	Power	Frequency range or Wavelength	Approx. range n. m.	Remarks
Long-range radio	Consol	Marconi		2.5 kW	LF/MF 255-415 kc/s	1300 (max.)	Rotating CW Beacon
	Dectra	Decca Navigator		50 kW	LF 84-86 kc/s	1300	Hyperbolic system
	Delrac	Decca Navigator		5 kW	VLF 10-16 kc/s	2600	Hyperbolic system
	HF D/F	Marconi	DFG 26/4		HF 1.5-21 Mc/s	850	Adcock system
	HF D/F	Standard T. & C.	PQ 3		HF 1.6-30 Mc/s	850	Commutated aerial—automatic
Medium and short-range radio	MF Beacon	Marconi	WB 8	2.5/3.3 kW	MF 200-415 kc/s		CW/MCW
	MF Beacon	Redifon	G 91	2.5 kW	MF 200-550 kc/s		CW/MCW
	MF Beacon	Redifon	G 40B	500-750 W	MF 137-550 kc/s		CW/MCW
	MF Beacon	Redifon	G 175	400 W	MF 200-420 kc/s		CW/MCW/RT
	MF Beacon	Marconi	AD 501	250-300 W	MF 200-415 kc/s		CW/MCW
	MF Beacon	Redifon	G 54	100 W	MF 250-500 kc/s		CW/MCW/RT
	MF Beacon	Redifon	G 142	80 W	MF 200-420 kc/s		CW/MCW
	MF Beacon	Marconi	AD 511	20 W	MF 200-415 kc/s		CW/MCW
	Decca Navigator	Decca Navigator		150-800 W	LF 84-86 kc/s	260	Hyperbolic system
	Gee	Cossor		25 kW	HF/VHF 20-85 Mc/s	400*	Hyperbolic system
	VOR	Standard T. & C.	BQ 1	300 W	VHF 112-118 Mc/s	120*	Omni-directional beacon
	VOR (High accuracy)	Standard T. & C.	BQ 2	300 W	VHF 112-118 Mc/s	120*	Omni-directional beacon
	VHF D/F	Marconi	AD 200		VHF 118-132 Mc/s	120*	Adcock-automatic
	VHF D/F	Marconi	AD 210		VHF 100-150 Mc/s	120*	Adcock-automatic
	VHF D/F	Standard T. & C.	PQ 1A		VHF 100-150 Mc/s	120*	Commutated aerial—automatic
	UHF D/F	Standard T. & C.	PQ 2A/1 (Marine)		UHF 225-400 Mc/s	120*	Commutated aerial—automatic
	UHF D/F	Standard T. & C.	PQ 2A/2		UHF 225-400 Mc/s	120*	Commutated aerial—automatic
	VHF D/F	Ekco	CE 12A		VHF 100-156 Mc/s	120*	Adcock-manual
	Tacan	Standard T. & C.	STURN 3	7 kW	UHF 1000 Mc/s	200*	Rho/theta
Medium and shortrange radar	DME	Murphy	RB 110 (Eureka Mk. 7)	1 kW	200-235 Mc/s	200*	Secondary radar
	Secondary Surveillance Radar	Cossor	Type 2	1-10 kW	1000 Mc/s	150*	Secondary radar
	Surveillance Radar	Marconi	Type S263	800 kW	10 cm	85*	Primary radar with MTI
	Height Finding Radar	Marconi	Type S239	800 kW	10 cm	150*	Primary radar with MTI
	Surveillance Radar	Decca Radar	MR 100	800 kW	10 cm	120*	Primary radar
	Surveillance Radar	Decca Radar	LR 250	$2^1/_2$ MW	10 cm	200*	Primary radar
	Height Finding Radar	Decca Radar	HF 200	$2^1/_2$ MW	10 cm	200*	Primary radar
Radio approach aids	ILS	Pye	PTC 1100				
	Localizer	Pye	—	50 W	108.1-112 Mc/s	40**	Radio Beam
	Glide Path Beacon	Pye	—	20 W	328.6-335.4 Mc/s	15**	Radio Beam
	Marker Beacons	Pye	—	3 W	75 Mc/s		
	ILS	Standard T. & C.	STAN 7/8				
	Localizer	Standard T. & C.	—	17 W	108.1-111.9 Mc/s	25**	Radio Beam
	Glide Path Beacon	Standard T. & C.	—	17 W	329.3-335 Mc/s	25**	Radio Beam
	Marker Beacons	Standard T. & C.	—	3 W	75 Mc/s		
Radar approach aids	Airfield Control Radar	Decca Radar	MR 75	250 kW	3 cm	75	Primary radar
	Airfield Control Radar	Marconi	S 232	60 kW	50 cm	60	Primary radar with MTI
	Airfield Control Radar	Marconi	S 264	60 kW	50 cm	130	Primary radar with MTI
	Airfield Control Radar	Marconi	S 264A	500 kW	50 cm	230	Primary radar with MTI
	Airfield Control Radar	Marconi	SNW 41	40 kW	3 cm	40	Primary radar
	Airfield Control Radar	Cossor	CR 21	500 kW	10 cm	70	Primary radar with MTI
	Airfield Control Radar	Decca Radar	424 Mk.2	30 kW	3 cm	25	Primary radar
	Precision Approach Radar	Standard T. & C.		50 kW	3 cm	8	Primary radar
	Radar Approach Aid	Ekco	CE 71	10 kW	3 cm	12	Primary radar with VHF D/F
Airfield control radar	Airfield Surface Movement Indicator	Decca Radar	ASMI Mk.1	15 kW	8 mm	8	Primary radar
Weather radar	Storm Warning Radar	Marconi	SNW 51	40 kW	3 cm	200	Primary radar
	Storm Warning Radar	Decca Radar	Type 40	15 kW	3 cm	120	Primary radar
	Storm Warning Radar	Decca Radar	Type 41	25 kW	3 cm	250	Primary radar
	Wind Finding Radar	Decca Radar	WFI		3 cm	50	Primary radar

* At 10,000 ft; ** at 2,000 ft.

Development and Production, International Air Power, Meteorology in War, Guided Missiles, etc. The book is a valuable contribution to the layman's understanding of today's complex international situation. Ed.

Parachutiste d'Essais, by André Allemand, illustrated by Jean Reschofsky. Published by Hachette, Paris, 1957 (French, 255 pages).

In his work as a Test Parachutist the author completed some 516 jumps, and achieved a world record for jumps from high speed aircraft. In 1952 a severe accident, after an emergency ejection from a 500 m.p.h. *Meteor*, brought his active career to an end. Based on his rich, if sometimes painful experiences, this book has warmth and excitement, and covers the whole history of parachuting. Allemand uses his own, and his colleagues' knowledge to discuss future ways and means of obtaining effective and safe ejection from high speed aircraft. An excellent and expert introduction to the "art".

Unarmed into Battle, the Story of the Air Observation Post. — By Maj. Gen. H. J. Parham and E.M.G. Belfield. — Published for the Air O.P. Officers' Association by Warren & Son Ltd., The Wykeham Press, Winchester, 1956 (English, 168 pages, 25s.).

One branch of military flying which contributed much to the success or failure of the great campaigns of World War II but has mostly been neglected by aviation writers at last receives the recognition it deserves. The book describes the early beginnings, the vicissitudes, setbacks and the yeoman work performed by the air Allied observers from the beginning of the war through the Western Desert, Tunisian, Sicilian, Normandy and Far Eastern campaigns. Hair-raising low flying was part of the job of these artillery officers-turned-R.A.F. pilots, operating light, mostly unarmed aircraft frequently within range of enemy small arms fire. There was further always the risk of being pounced upon by enemy fighter aircraft. Rarely they carried parachutes, chiefly because they were ineffective at the low heights at which the Air O.P. normally operated. — A tribute to a gallant band of unspectacular daredevils. Ed.

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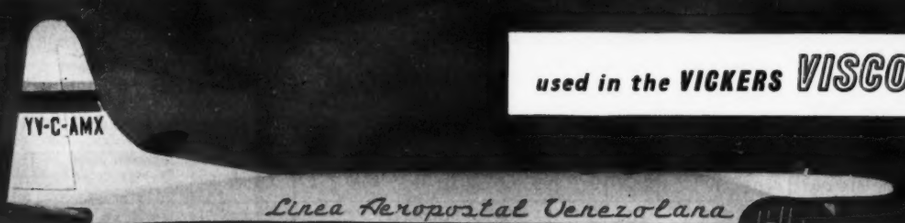

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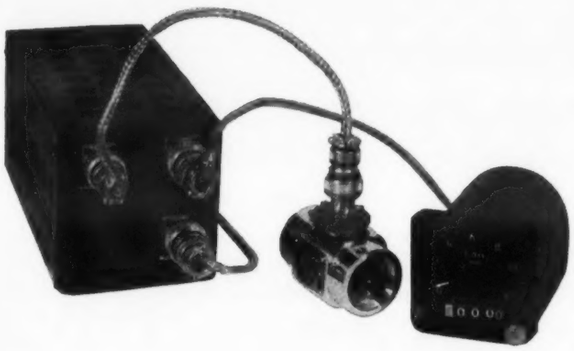

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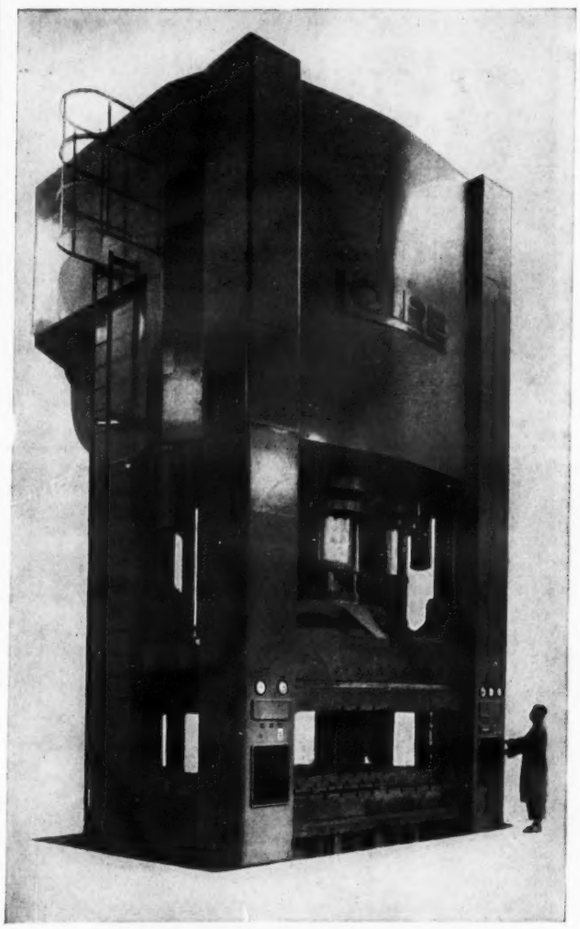

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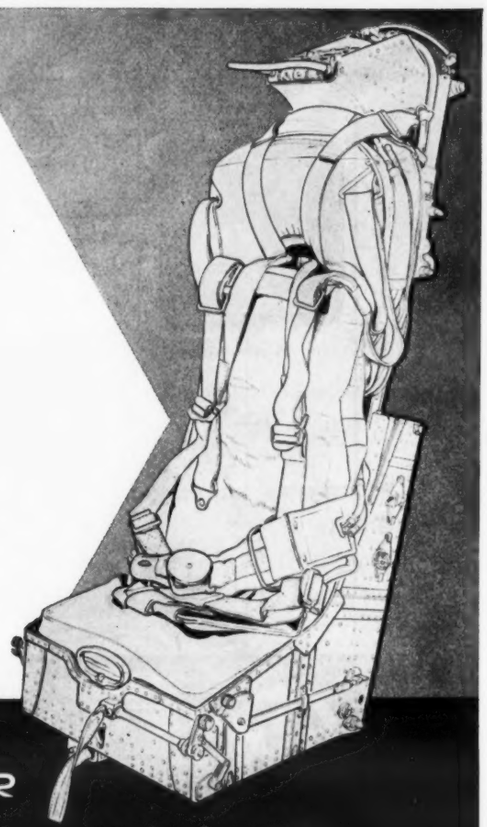

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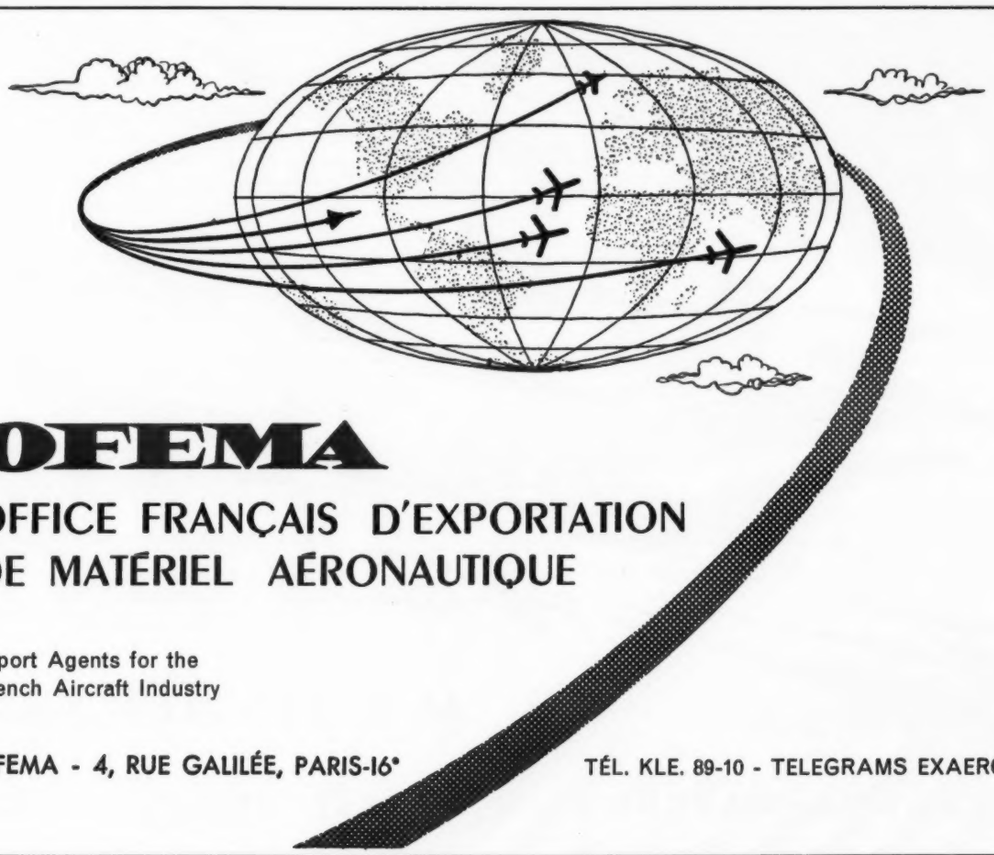

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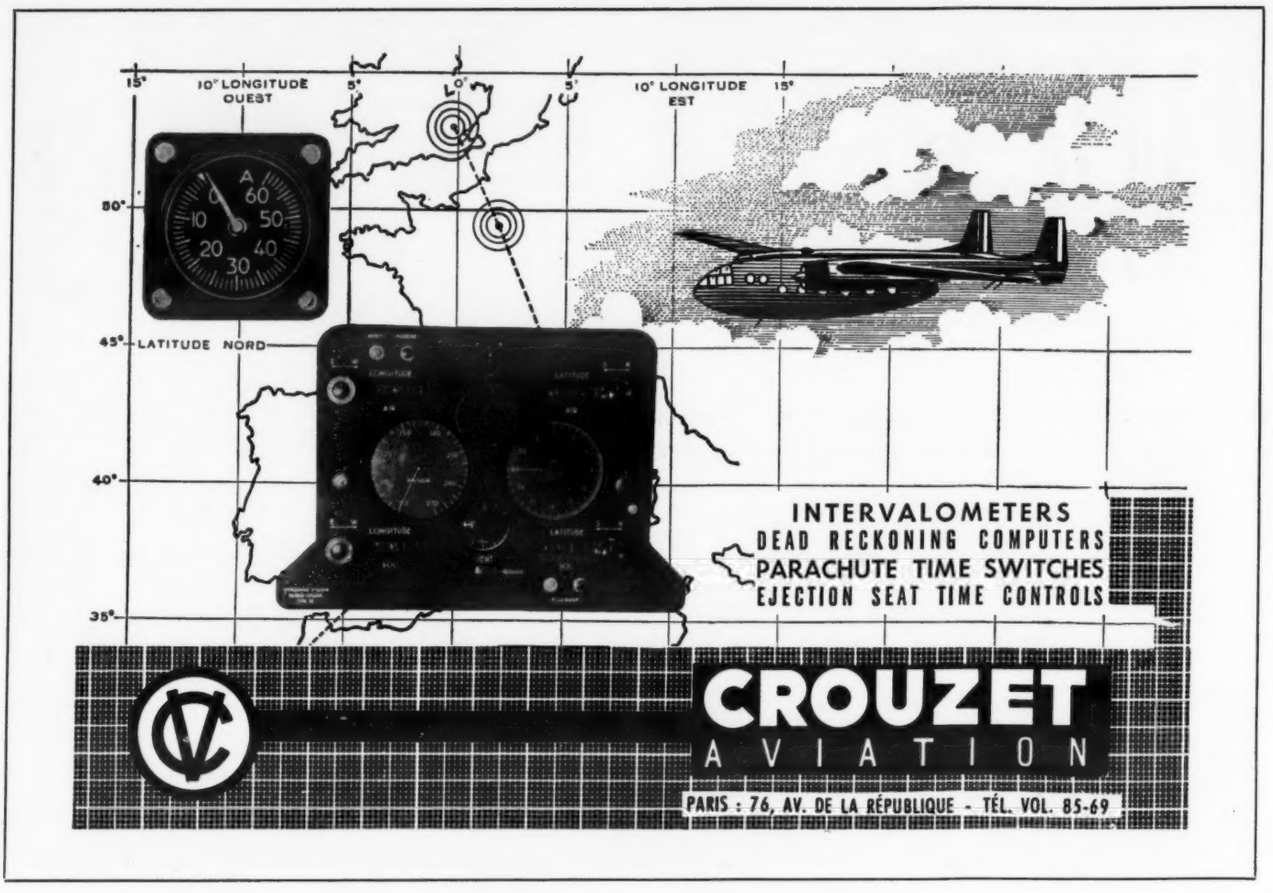

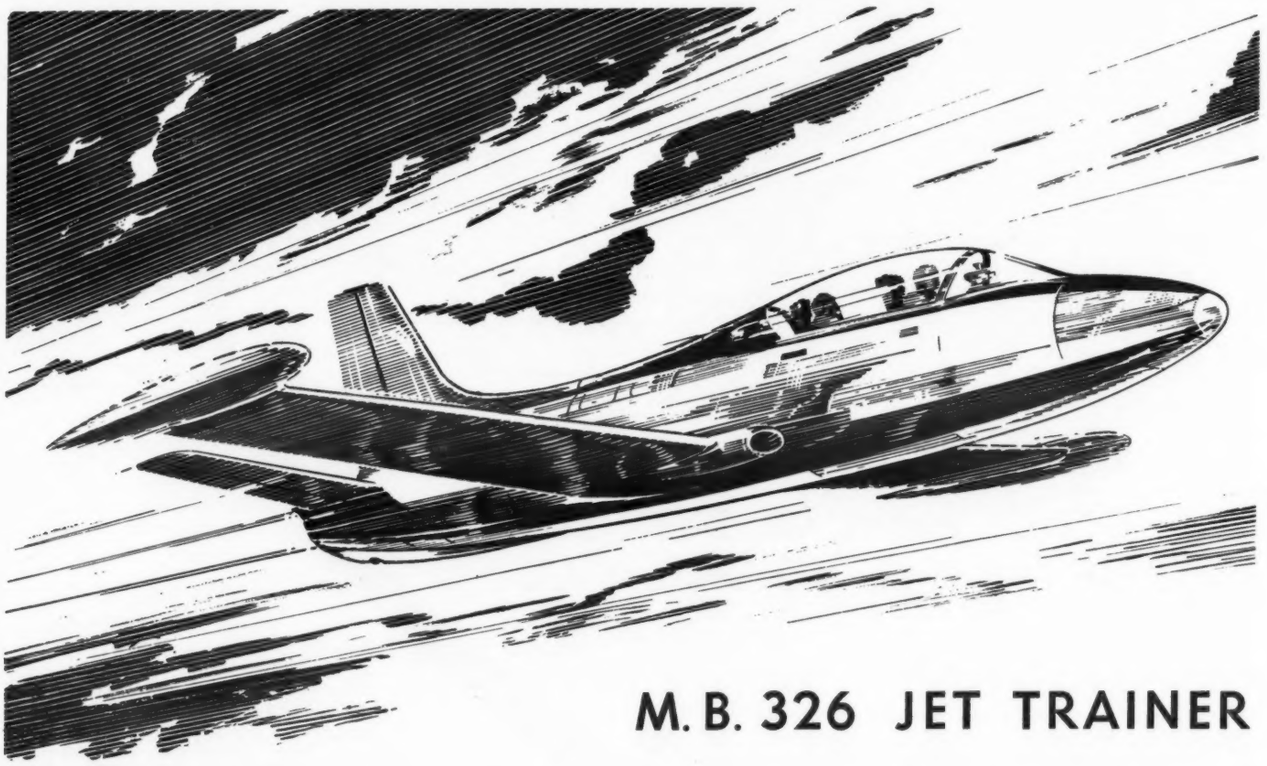

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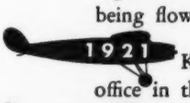
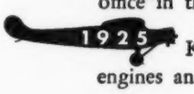
KLM inaugurates the Amsterdam-London flight which is the *oldest* air route in the world still being flown by the same carrier.

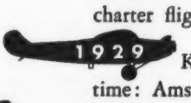


KLM opens the *first* air traffic booking office in the world.

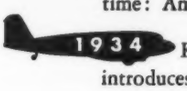


KLM is the *first* to make use of air-cooled engines and all-metal propellers.

1927 - KLM makes the world's *first* intercontinental charter flights.

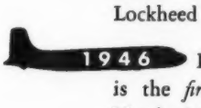


KLM opens the *longest* air route of that time: Amsterdam-Jacarta.



KLM, as the *first* airline outside the U.S.A., introduces all-metal Douglas DC-2 and wins the London-Melbourne Air Race. Two years later KLM is the first European company to buy the DC-3.

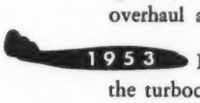
1943 - KLM, as first non-U.S.A. carrier, orders the Lockheed Constellation.



KLM, though heavily shattered by the war, is the *first* European airline to open a post-war North Atlantic service.

1948 - KLM is the first European airline to buy the Convair Liner.

1950 - KLM is the first European airline to be specially authorized by the U.S. Government to overhaul aircraft of U.S. air companies.



KLM is the world's first airline to operate the turbocompounded Lockheed Super Constellation.

1956 - KLM is the *first* carrier outside the U.S.A. to order the jet-engined Douglas DC-8 and the turboprop Lockheed Electra.

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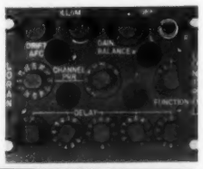

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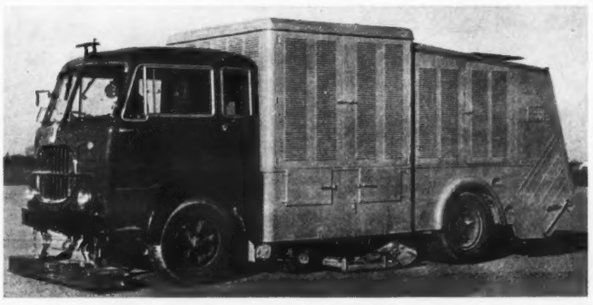

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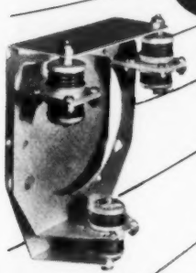

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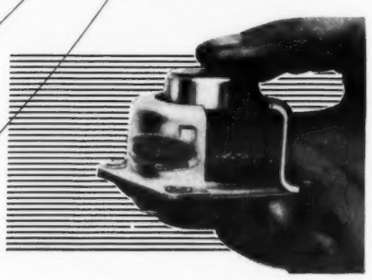

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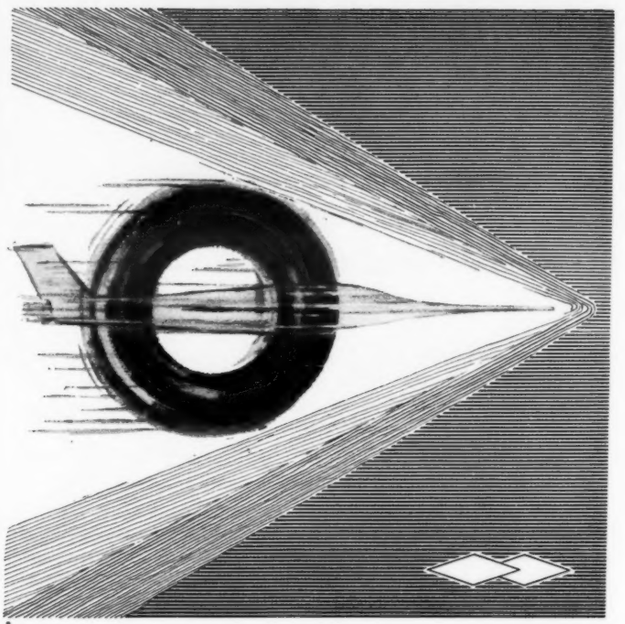

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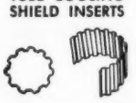

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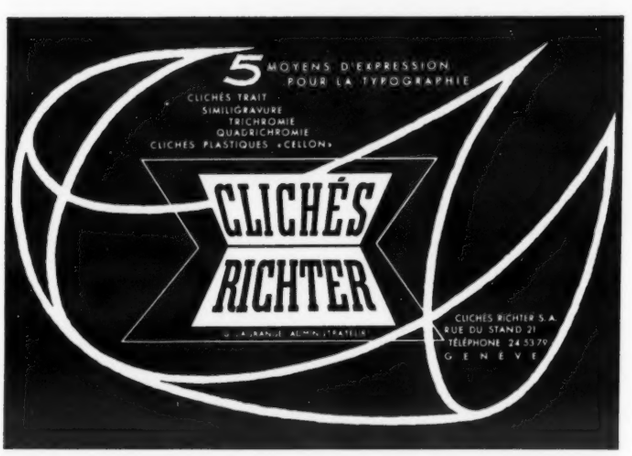

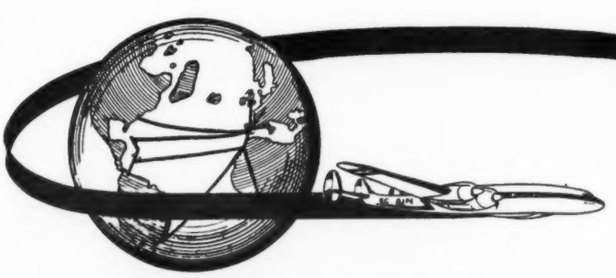

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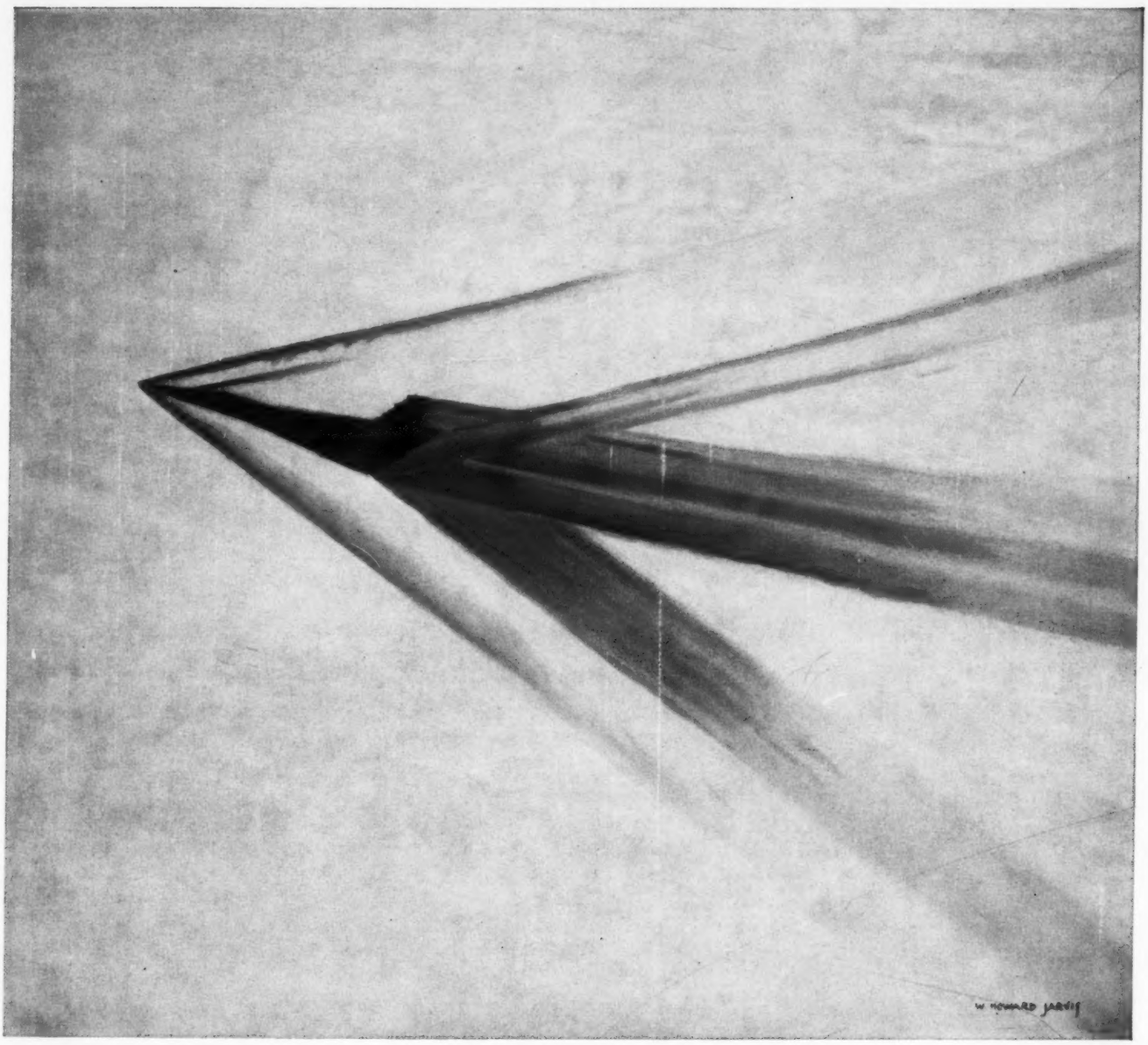

A series of paintings by W. Howard Jarvis, S.Av.A., illustrating aerodynamic shock-waves

M = 2·4

No. 4

A climbing flight-path at M=2.4. The angle of the bow-waves and of the shock-wedge pattern on the wings decreases in direct proportion to the aircraft's velocity. It is given by the simple trigonometrical function $\frac{\alpha}{2} = \text{Sin}^{-1} \frac{va}{V}$ where α is the angle between the shock-waves, V is the velocity of the aircraft and va the local speed of sound.

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